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THE HALL OF FAME

It cannot be denied that considerable interest attached to the opening of the Hall of Fame at the University of New York last week on Decoration Day. The building is the gift of Miss Gould, and may therefore be fairly said to represent in a measure the profits secured by her father from his connection with telegraphy. It is thus one of the very few public benefactions that can be traced to electricity, and is comparable with the creation of Cornell, although Cornell is infinitely the more useful gift of the two. Yet it is only fit and proper to commend highly the generous impulse to which Miss Gould yielded, and to express pleasure that her broad liberality has found once again so worthy an object. We do not believe that such institutions as Halls of Fame can be set going "ready made," so to speak, but the beautiful building at University Heights will doubtless illustrate slow and healthy growth. It starts well, to say the least. Every name on its tablets is a worthy one, and that, of course, is more than can be said of the "immortals" distinguished in Westminster Abbey or the Pantheon in Paris, in St. Paul's Cathedral or at Versailles. One is glad to hail Morse there, but it grates to see the names of Morse and Whitney listed as those of "scientists," and to find the great name of Henry omitted. But there will be many changes even in the first hundred years. There are only 29 names now on the bronze tablets; and, all in all, they serve to mark this soil of the New World as a fertile breeding ground of great men. Incidentally, it is satisfactory to note the prominence of the American Institute of Electrical Engineers, and of the New York Electrical Society in the proceedings.

INDEPENDENT TELEPHONY.

The vigorous manner in which the independent telephone movement is being pushed is well indicated by our issue this week. The careful and thorough equipment of independent exchanges with modern, standard apparatus is illustrated by such a plant as that at the Scranton exchange, while the general conditions throughout the country are treated most interestingly in the interview accorded by Judge Thomas to our Cleveland correspondent. The data of progress presented by Judge Thomas will surprise many people, but it cannot be gainsaid or pushed aside. It will be seen that no expectation is entertained in such influential quarters of closer co-operation with the Bell system; in fact, we are promised the continued existence of two actively opposed systems. If this is to be the case, the advance of telephony during the next ten years will be made at a tremendous pace, while so great is the demand to be met, it by no means follows that the service to the public will be done at a loss, as it has been in telegraphy when rates have been cut to secure a business which even serious reductions did little to increase in volume. With telephony it is certainly different, and the lowering of rates has been marked by striking gains in volume. On this point, a well-known European expert, Mr. G. de la Touanne, contributes to our pages this week a valuable analysis of the Bell figures, being the only ones fully available for the United States. It will be interesting to note how these figures and the conclusions now fairly derivable from them are modified by "independent" influences during the next five years.

THE INDUCTION MOTOR.

Elsewhere we print an article by Mr. Ralph D. Mershon, which forms an interesting and very timely contribution to the literature of the induction motor. It is agreeable to note that while the object of the article is to bring into relief the merits of the induction motor

for general power service, and to correct a number of misconceptions concerning it which exist, the writer in his comparisons with the direct-current motor does not manifest the partisan spirit toward the latter which is usually in evidence when the claims for its modern competitor are being set forth. As to the misunderstandings concerning the induction motor—and these are surprisingly numerous—most appear to be due to an entire lack of knowledge of its principles or to a mistaken idea that this piece of apparatus—unlike all other electrical apparatus—admits of little flexibility of design.

One of the fallacies with respect to the induction motor which, happily, is becoming generally recognized as a fallacy, is that it is inefficient in starting torque. In point of fact, the starting torque of this type of motor may be designed for any value within reason, and, as pointed out by Mr. Mershon, it is usually several times the full-load torque. As to disturbing effect in starting up, this is also shown to be largely imaginary. When a sudden demand is made upon any energy supply system, a temporary disturbance is necessarily created corresponding to the extent of the momentary demand; but this fact has not influenced the installation of direct-current motors, and can also be dismissed in relation to the induction motor. Another widespread fallacy is that the power factor of the induction motor is necessarily low, whereas this factor can be controlled by the designer within wide limits. Recent requirements of a power factor of .92 have been met by the manufacturers, and a power factor as high as .96 has been realized. As in the case of any other machine, attaining an ideal piece of apparatus is largely a commercial question; that is to say, if one is willing to pay for refinements he can obtain them, either in the direct-current or in the induction motor—at a price. We commend to the reader Mr. Mershon's discussion of the power factor in its bearing on operation. This side of the subject has been particularly clouded, but, as pointed out by Mr. Mershon, the consumer can dismiss the matter as one in which he has little or no concern, the problem being one for the plant engineer, who can always find the necessary solution.

The power factor bugbear has doubtless led to the advocacy of the synchronous motor for use in cases where otherwise it would not be considered. While this type of motor has its field—and an important one—Mr. Mershon gives very cogent reasons why it is not suitable for general power service. While it is true that the synchronous motor will serve as a regulator on polyphase circuits, to utilize this property requires close attention during operation. Should the field excitation not be kept at exactly the right point, this type of motor will introduce a disturbing influence which can greatly aggravate the evil which it has been installed to overcome, through giving rise to the equivalent of a power factor. In addition, the synchronous motor may possess the equivalent of a power factor in another respect unless its curve of e. m. f. coincides exactly with that of the supply circuit; for should this not be the case, there will be an exchange of idle current between the motor and the line. Moreover, should the synchronous motor have an e. m. f. curve corresponding to that of the line at one excitation, this correspondence may not exist at higher or at lower excitations. We have merely touched upon a few points brought out in Mr. Mershon's admirable article, the careful reading of which will abundantly repay those at all interested in the subject.

STANDARDIZING ENGINE TESTS.

At the recent Milwaukee meeting of the American Society of Mechanical Engineers a preliminary report of the committee appointed to codify and standardize the methods of making engine tests was presented, which contains a great deal of interesting material for the guidance of those who measure the performance of steam, gas and oil engines. In reading these directions one is struck by the fact that the determination of the losses and wastes of power in a heat engine, say, of the ordinary multi-cylinder steam engine type, is much more difficult and liable to error than the determination of the losses of power in the dynamo-electric machine, say of the ordinary alternator type. In other words, steam engineers have a much harder task to determine the efficiency of the steam engine than has the electrical engineer to determine the efficiency of a dynamo, assuming corresponding facilities offered for making observations in the two cases.

Although the paper is thoroughly practical, yet we think there is certainly room for improvement in a few matters of terminology. For example, it is stated that the standard efficiency of an engine is recommended to be defined as the number of British thermal units consumed by the engine, either per indicated or per brake horse-power hour. The "thermal efficiency ratio" is then defined as the proportion which the heat equivalent of the power developed bears to the total amount of heat actually consumed. The latter definition is a logical one—except that the word "ratio" is obviously superfluous—and is in conformity with all modern terminology in electrical engineering, since it is a ratio of power output to power input, and is a numerical fraction which increases as the engine improves. But it is both illogical and misleading to designate the heat units consumed per indicated or brake horse-power-hour, as a standard of efficiency. On the contrary, it is a standard of inefficiency; it is a ratio of energy input expressed as heat, to energy output expressed as mechanical activity, and, consequently, it is essentially of the nature of the reciprocal of thermal efficiency.. Consequently, to call an inefficiency a standard of efficiency is not only misleading, but as the engine is improved and becomes more efficient, the thermal units consumed per horse-power hour diminish and the standard of efficiency, as thus expressed numerically, diminishes instead of increasing.

Of course, there can be no dispute as to the facts of the case, or as to the desirability of having a standard of comparison between engines based upon the consumption of heat per ihp-hour. Our criticism is solely directed to the name of this standard, which should not be called an efficiency, or classed as an efficiency, when it is really of the nature of an inefficiency. We think that what the report calls the "thermal efficiency ratio" should be altered to "thermal efficiency" simply, and that this "standard efficiency," or "standard efficiency result," of British thermal units per horse-power-hour, should be called a standard heat consumption, or some term independent of the term "efficiency." The British Society avoided in their report of 1898 the errors referred to. A similar anomaly and misuse of terms is met with in the common expression "efficiency of an incandescent lamp," defined as the ratio of the power it consumes to the luminous intensity it produces. This definition, which is illogical, gives rise to the ridiculous result that the greater the numerical efficiency of a lamp, the less efficient the lamp becomes.

The report contains many useful and significant items of practical information. For example, it is stated that if a single indicator be employed for taking diagrams in succession upon the front and rear ends of a steam cylinder by means of a three-way cock, instead of using an indicator at each end of the cylinder, an error may be produced which has been found to range between 3 per cent and 7 per cent. This error is due to the drop of pressure in the short lengths of pipe connecting the indicator cylinder with the two ends of the working cylinder under test, and it is stated ordinarily to have the

effect of unduly enlarging the area of the diagram and, therefore, of unduly increasing the indicated power of the engine. Standard test sheet forms are appended for itemizing the various measured quantities.

THE VELOCITY OF VISIBLE LIGHT AND THE VELOCITY OF ELECTRO-MAGNETIC WAVES.

In the report of the International Physical Congress of 1900 in Paris, there appear two papers in immediate succession, the first of which, by M. Cornu, discusses the most reliable measurements of the velocity of light in vacuo, and the second, by M. Abraham, discusses the most reliable measurements of the electromagnetic velocity v, which is the ratio involved between the magnitudes of electrostatic and electromagnetic units. The two quantities are essentially distinct, although, of course, they are fundamentally in close connection. The one deals with the speed at which beams of light, visible to the eye, advance in air, as measured by purely optical apparatus, while the other deals with a physical ratio quantity deducible from accurate measurements of the same physical quantity, such as the capacity of a condenser, in both electrostatic and electromagnetic measure. It was Clerk Maxwell who first recognized that the latter ratio meant a velocity, and that this velocity was nothing else than a light-velocity. At first the interest was solely confined to proving experimentally that the ratio v was within observational limits of error, the same as the velocity of light. Later, however, a new interest has arisen in seeing how closely both v and the light-velocity in free space approach to the round number of 300,000 kilometers per second.

Two methods of measuring the light speed in air are well known, one being that of the displacement of an image produced by a rapidly revolving mirror, and the other that of interception of a far journeying beam of reflected light, by the teeth of a revolving toothed wheel. The former Michelson found to give a light speed, in vacuo, of a little less than three 10-meters, or 299,860 kilometers per second, while the latter gave a speed a little more than three 10-meters, or 300,400 kilometers per second. Although the probable error of observation assigned to the latter is 10 times larger than that of the former, yet M. Cornu, after an elaborate discussion of the causes and liabilities to error in the two cases, takes the simple mean as the most probable result, namely, 300,130 kilometers per second as the velocity of light in vacuo, with a probable error of 270, or less than one-tenth of one per cent.

Turning now to the electromagnetic measurements of v, about 25 different sets of results are considered, as obtained by different observers, and the most promising of these are selected, leading to a mean result, which, corrected for the presence of the air, as the medium in which the measurements were made, and reduced to vacuum or free space, gives a speed ratio v of 300,100 kilometers per second. This result, therefore, agrees with the mean reduced speed of visible light, according to Cornu, within 30 kilometers per second, or considerably less than the probable error of either set of determinations. In view of the magnitude of this probable error, it is still too early to decide whether the light speed and v-speed are greater or less than three 10-meters per second. Expressing the same idea in different language, it is not yet certain whether the electrostatic unit of e. m. f. is less or more than 300 volts, or whether the electrostatic unit of resistance is less or more than 900,000 megohms, but the real values cannot be far from these, either one way or the other.

A paper by M. Blondot in the same volume, discusses and compares the results obtained upon the speed of propagation of electromagnetic waves running along wires. These measurements are intermediate in character between the purely optical measurements of visible light waves, and the purely electrical measurements of the v-speed ratio. They involve high-tension currents of brief duration along metallic wires with spark gaps set at definite points thereon, and observations either of nodal distances, or of the time elapsing between sparks at successive gaps, with the aid of a rapidly revolving mirror. The mean of five sets of measurements by different observers is 2,992,000 kilometers per second, as the speed of the waves referred to vacuo, or corrected for the retardation of air, i. e., a little less than three 10-meters per second.

Several remarkable conclusions are deducible from these interesting papers. In the first place, it would seem that whatever refinements and corrections future determinations may effect in the results, it is safe to say that the speed of light is, for all practical purposes three 10-meters per second. In other words, we may consider that the international kilometer may be regarded either as very nearly the ten-thousandth part of the quadrant of the earth measured along the Paris meridian or as very nearly the 1-300,000 part of the distance through which light runs in free space in a mean solar second of time, which means that by a curious coincidence light has a speed of very nearly 30 earth quadrants, or 7½ earth circumferences per second. Secondly, that the speed of transmission of electromagnetic waves in free space must be the same, within a very minute amount, for waves having a length of many kilometers on the one hand, or of a fraction of a micron on the other. In other words, the speed must be independent of the frequency, or wave length, within at all events extremely small limits. Thirdly, that the speed of transmission of electromagnetic waves in free space must be the same within a very minute amount for waves of large amplitude and waves of small amplitude. In other words, the speed of transmission appears to be unaffected either by the amplitude or by the energy of the electromagnetic waves. Fourthly, the mechanism by which electric currents flow along wires is a purely optical one, consisting in the traveling of electric waves along the surface of the wire, the wave front having the form of a sheet to which the wire is very nearly perpendicular. In other words, and conversely, the optical transmission of beams of light through space is a purely electromagnetic process of electric wave-transmission, in the absence of electric guiding conductors, as was first announced by Maxwell. Fifthly, the speed of transmission of electric disturbances over wires is nothing less than the speed of light through the dielectric medium surrounding and enveloping those wires, and is always something less than three 10-meters per second, which would be the speed of transmission in free space. The speed of transmission of signals or impulses over wires in the telegraphic sense is, however, much less than the light-speed, by reason of the absorption or reflection of the impulses and of their energy in the dielectric due to electrostatic and electromagentic inertia. Sixthly, electric currents are electric wave-trains having their seat in the medium surrounding the conductor, which is a mere guide-hole in the dielectric over which they run, and the only place where no electric current, in this sense, really exists. The energy of the advancing waves is slowly expended in the conductor, owing to its imperfect conducting power, whereby after a given wave has traveled around an electric circuit a certain number of times, it disappears, having become completely absorbed, and dissipated as heat. Seventhly, that Ohm's law is a remarkable summation law, dealing with and embracing the total quantity of waves that emerge from the source and remain in existence at any one instant of time over the conductor, after attaining the steady state, and in all stages of strength between initial full power and final disappearance by exhaustion.

Opening of the Hall of Fame.

As a great many of our readers are probably aware, New York University, at University Heights, has had added to it, largely through the generosity of Miss Helen Gould, a Hall of Fame. This structure is a splendid colonnade 500 ft. in length and surrounding circularly the beautiful library building of the University. The Hall of Fame is intended to contain memorial tablets and busts of great Americans, and the selections are made by vote, the electors being themselves a chosen few, leaders in every department of intellectual activity. The cost of the Hall of Fame is said to be about $100,000. Each of the tablets within it is about 10 ft. long and 1 ft. high, of bronze. The name is carved in large letters, and under each name are a few words of tribute. At the present time the electors have chosen 29 names, and there are, therefore, 29 tablets, which were unveiled on Decoration Day, May 30. Chancellor MacCracken states that the electors will continue to serve, and that according to the terms of the gift, 150 names are to be honored by tablets by the year 2000. The names are divided into seven groups, one of which is called that of scientists, and in this are included the names of Fulton, Morse and Whitney. At the ceremonies on Thursday last the Morse tablet was unveiled by Mr. Gano S. Dunn, assisted by Mr. Francis W. Jones, to represent the American Institute of Electrical Engineers, on the nomination of the president of the Institute. The New York Electrical Society was represented by President T. C. Martin and Secretary G. H. Guy, and it is an interesting coincidence that Mr. Jones was the first president of the Electrical Society and Mr. Dunn the

SAMVEL FINLEY BREESE MORSE
1791 1872
I AM PERSVADED THAT WHATEVER FACILITATES INTERCOVRSE BETWEEN THE DIFFERENT PORTIONS OF THE HVMAN FAMILY WILL HAVE THE EFFECT VNDER THE GVIDANCE OF SOVND MORAL PRINCIPLES TO PROMOTE THE BEST INTERESTS OF MAN

MORSE TABLET.

president in 1899-1900, so that the society was remarkably well in evidence on this interesting occasion.

The inaugural oration was made by Senator Depew, who, in the course of an admirable address, said: "If the Viking could come from his Valhalla, the Areopagite from beneath the temples at Athens, the arbiter elegantiae from the ruins of Rome, the mediaeval knight from his armor, Frederick from Potsdam, or Napoleon from the Invalides, to view these our heroes, they would have only contempt for this development of democracy. The inventor of the application of steam to navigation, of the electric telegraph and of the cotton gin, the artisans who were in their time and to their world the herd or mass born to bear the burdens and work for the luxuries of their masters, are here crowned with the fadeless laurels which encircle the brows of the conquerors and rulers of the world. Eli Whitney transformed half a continent from a wilderness to one of the most productive of territories; Fulton made possible transportation by water and land, which has given to our country its prosperous population and vigorous States, and the leadership in the industrial competition of nations, and Morse added new strength to our Union by discoveries in electrical power, which, from his initiative, have enormously developed the resources of his country, and given opportunity and employment to his countrymen."

He added: "We have now no Tennysons, nor Longfellows, nor Hawthornes, nor Emersons. Perhaps it is because our Michael Angelos are planning tunnels under rivers and through mountains for the connection of vast systems of railways, and our Raphaels are devising some novel method for the utilization of electrical power; our Shakespeares are forming gigantic combinations of corporate bodies, our Tennysons are giving rein to fancy and imagination in wild speculations in stocks, and our Hawthornes and Emersons have abandoned the communings with and revelations of the spirit and soul which lift their readers to a vision of the higher life and the joy of its inspiration, to exploit mines and factories. When this period of evolution is over, and nations and communities have become adjusted to normal conditions, the fever and the passion of the race for quick wealth and enormous riches will be over. Then the grove, the academy and the study will again become tenanted with philosophers, poets, historians and interpreters of God in man. Unless this shall happen, then let the luxuries and opportunities, evanescent earthly pleasures, and the disappearance after death which come from leadership in business be the rewards of the successful; but reserve the Temple of Fame for those only whose deeds and thoughts are the inheritance, education, inspiration and aspiration of endless generations."

A great many electrical people were among the invited guests on this interesting occasion, and it is interesting to note that a prominent place was given to Mr. E. L. Morse, of Washington, D. C., son of Professor Morse.

The Independent Telephone Convention.

The Independent Telephone Association of the United States of America will hold its fifth annual convention at Buffalo on June 11, 12 and 13, with headquarters at the Hotel Iroquois. The programme is given below:

TUESDAY MORNING.

Reception of delegates, distribution of badges, tickets, etc., at headquarters, Iroquois Hotel.

MORNING SESSION—NOON.

Opening of the convention, in the banquet room of the city Convention Hall, corner Virginia Street and Elmwood Avenue.

Address of welcome, Hon. Conrad Diehl, Mayor of Buffalo; response by James M. Thomas, of Cleveland, president Independent Telephone Association of the United States; annual address by the president of the association, Hon. James M. Thomas.

AFTERNOON.

Inspection of exhibits made by manufacturers, in connection with headquarters at Iroquois Hotel.

WEDNESDAY.

Morning session, 10 a. m., at Convention Hall.

Paper by Hon. S. P. Sheerin, new Long Distance Telephone Company, of Indianapolis. Subject, "Village Exchanges and Farmers' Lines." Discussion by J. B. Ware, of People's Telephone Company, Detroit, Mich., and T. J. Fricker, of Ashtabula Telephone Company, Ashtabula, Ohio. Paper by Chas. E. Wilson, of Keystone Telephone Company, Philadelphia. Subject, "Independent Telephone Development East of the Alleghanies." Discussion by C. E. Stinson, Rochester Telephone Company, Rochester, N. Y., and Senator C. W. Kline, of Hazelton, Pa., president Interstate Telephone & Telegraph Company, of Pennsylvania. Paper by L. W. Stanton, Cleveland, Ohio. Subject, "Exchange Service." Discussion by convention-at-large. Reports from various States and other business.

AFTERNOON.

Inspection of exhibits by manufacturers, in connection with headquarters at Iroquois Hotel. Pan-American Exhibition and Niagara Falls.

THURSDAY.

Morning session, 10 a. m., at Convention Hall.

Reading of paper by H. D. Critchfield, general counsel, Cuyahoga and United States Telephone companies, Cleveland, Ohio. Subject, "Legislation and Litigation." Discussion by Ed. Kibler, of Newark Telephone Company, Newark, Ohio, and C. S. Bash, Home Telephone Company, Ft. Wayne, Ind. Reading of paper by E. B. Fisher, of Citizens' Telephone Company, Grand Rapids, Mich. Subject, "Bell Methods." Discussion by George W. Beers, of National Telephone & Telegraph Company, Ft. Wayne, Ind., and W. A. Bisbee, of Georgia Telephone & Telegraph Company, Savannah, Ga. Election of officers and unfinished business.

Popular Lectures.

At the annual dinner which was recently given to the lecturers of the New York Board of Education, Dr. Henry Leipziger, the efficient supervisor of the lecture system, stated that the work was now 12 years old. The attendance in the past year was 533,000 in Manhattan and Bronx. During the season from October to May, 1963 lectures were given. Among the lectures on electricity, etc., we may add were W. W. Ker, Max Loewenthal, T. I. Jones, W. J. Clark and S. D. Benoliel. Mr. Ker gave no fewer than 47 excellent lectures, and of these 17 were in one course, the average attendance being nearly 300, showing a sustained interest. We know of no better educational work being done in New York City than that which Dr. Leipziger conducts.

A European Study of American Telephone Statistics.

BY G. DE LA TOUANNE.

EVERY one knows the care with which, almost since the beginning, the American Bell Telephone Company (now the American Telephone & Telegraph Company), has collected the different data from the telephone systems worked by its licensees; but few realize what profit can be derived from such statistics even under unfavorable circumstances.

The following is a summary of some of said data since Jan. 1, 1884:

Jan., 1st Year.	Total Stations.	Mean number of stations.	Total of exchange connections per year in the U.S.	Miles of Wires, Jan. 1.		
				On poles and Underground Buildings and submarine.		Extra-territorial and toll lines.
	I.	II.	III.	IV.	V.	VI.
1884	123,625	129,236	215,280,000	85,896	.....	29,359
1885	134,847	136,298	251,268,000	100,367	1,225	35,631
1886	137,750	142,404	272,479,000	110,375	3,671	41,745
1887	147,068	152,890	312,606,000	121,936	6,295	43,767
1888	158,712	165,083	369,204,000	138,064	8,374	56,179
1889	171,454	178,228	383,822,000	152,897	17,574	73,293
1890	185,003	193,967	400,000,000	165,493	27,720	86,728
1891	202,931	209,474	450,000,000	184,943	55,469	91,230
1892	216,017	224,028	500,000,000	195,093	71,363	115,088
1893	232,140	234,663	600,000,000	210,239	91,552	133,002
1894	237,186	240,309	600,000,000	231,168	122,212	154,106
1895	243,432	262,563	670,000,000	246,533	150,131	180,557
1896	281,695	303,469	757,000,000	273,185	186,543	215,687
1897	325,244	354,737	847,000,000	299,226	237,619	268,866
1898	384,230	424,705	998,000,000	341,091	285,309	324,883
1899	465,180	549,063	1,231,000,000	411,832	360,157	385,911
1900	632,946	716,913	1,825,000,000	524,123	492,654	501,832
1901	800,830	.....	.....	644,730	709,472	607,599

From the above figures it would be hard to get any conclusions, and curves drawn from them will make the comparisons easier. Those on diagram No. 1 correspond with the figures in the columns similarly numbered in the above table. The general appearance of these curves would make one think that there is some simple law from which the growth of the business in the next one or two years can be rather exactly foreseen. That would be a hasty and incorrect conclusion, for the rate of increase for any of the curves seems to grow from year to year, and it is absurd to suppose that such a law can stand indefinitely. It is evident that at some time the rate of increase must stop growing, become uniform and perhaps decrease; for instance, it is obvious that, above a certain value, the number of subscribers could not increase faster than the population.[1] But as the absolute form of the curve results from the choice of the unit length for each of the co-ordinates, it is safer to examine separately the rate of increase, i. e., such quotients as $\frac{134,847-123,625}{123,625} = 0.09$. For instance, the yearly percentage of increase for the number of stations reads as follows:

1884	9.0	1893	2.1
1885	2.1	1894	2.6
1886	6.7	1895	15.
1887	7.9	1896	15.
1888	8.	1897	18.
1889	7.8	1898	21.
1890	9.6	1899	36.
1891	6.4	1900	26.
1892	7.4		

These figures show that it was necesary to ascertain if the annual rate of increase were responsive to some law, and that, unfortunately, there is no such law. If the data were those of a special exchange, it would be interesting, and it would be profitable, to examine if there is some relation between the variations in the rate of increase and the variations in the system of tariff, but that is not the case, and notwithstanding that uncertainty we are entitled to state:

First.—That, as to the development in the number of subscribers, the tariff system of to-day seems to be a right one, and,

Second, that when there is some real estate to buy, some new building to erect, some cable system to arrange; in other words, some permanent and lasting installation to make, it is better to provide for a coming increase of the business several times larger than ought to be expected as judged from the average increase in recent years. We shall possibly reach a time of telephone expansion, where every one will use telephones to the same extent as steam heaters, electric light and street cars.

Similar warning is given by the figures concerning the increase in mileage of overhead wires.

[1] The highest percentage of increase for the population of the United States has been registered at the 1810 census, where it was 36.38 per cent since 1800; for the 1900 census it was 21 per cent on the figures of 1890.

Mileage of Wires on Poles and on Buildings.					
Year.	Increase.		Year.	Increase	
	Absolute.	Per Cent.		Absolute.	Per Cent.
1884	14,471	16	1893	14,929	7
1885	10,008	9	1894	15,365	6
1886	11,561	10	1895	26,652	10
1887	16,128	13	1896	26,041	9
1888	14,833	10	1897	41,865	13
1889	12,596	8	1898	70,741	20
1890	19,450	11	1899	112,291	27
1891	10,150	5	1900	120,607	23
1892	21,146	10			

It is very necessary to watch the next possibilities, as it has happened that even telephone experts have been deceived by the sudden growth of the exchanges.

Diagram No. 1 teaches yet another thing, that is the growing importance of underground (and underwater, but that is negligible) wires compared with overhead wires. Amounting to no miles against 85,896 miles of overhead wires on Jan. 1, 1884, the underground wires

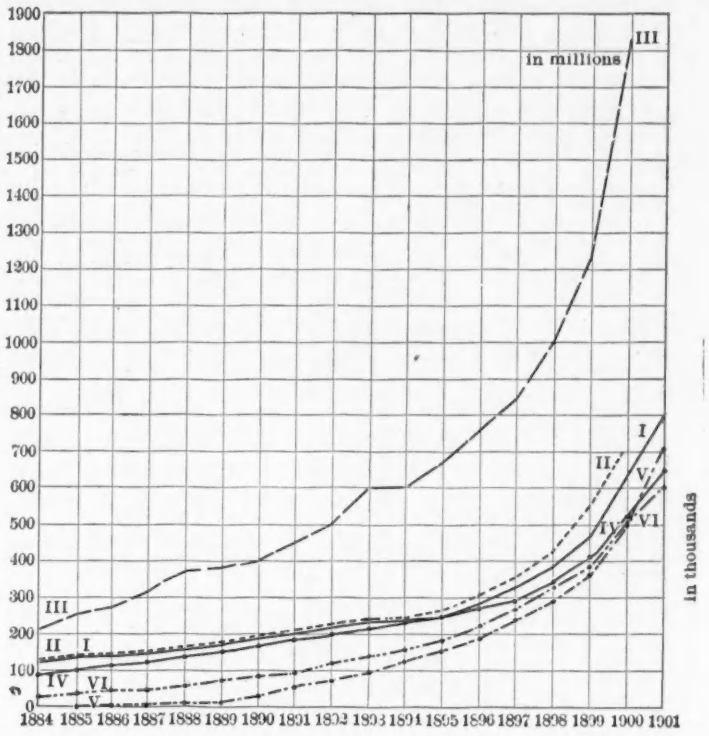


FIG. 1.

I.—Number of stations on January 1st.
II.—Mean number of stations per year.
III.—Total exchange connections per year.
IV.—Miles of wires, January 1st, on poles or buildings.
V.—Miles of wires, January 1st, underground or elsewhere.
VI.—Miles of wires, January 1st, on extraterritorial or toll lines.

represented in 1889 0.11 of the total mileage of exchange conductors, 0.34 in 1894, 0.46 in 1899 and 0.52 in 1901. It is proper to take note of the fact, as one might have expected, that the influence of the underground work was limited to the business portion of the very large cities, and partially veiled by the influence of the outside and residence parts of the same cities, as well as by the less important and almost exclusively overhead systems.

Finally, we have plotted on diagram No. 1 the curve of the mean number of stations for every year. The reason for so doing is that in several instances, especially in regard to the tariff question, what matters is not the absolute mileage of wire, the absolute number of exchange connections, etc., but to compare these absolute figures with what may be called the subscriber unit. For instance, one wants to know the number of connections per subscriber. The process by which the result is obtained is generally the following: The number of connections during the whole year is divided by the number of subscribers on Jan. 1 or on Dec. 31 of the said year. Well, this does

not seem justified, as the result of the calculation may be perfectly misleading. We ought to divide the number of connections by the arithmetical mean of the number of subscribers during the year; that is to say, the number of subscribers who are supposed to have used the telephone all the year round, would, as a total, have enjoyed the use of their station as many days as did the subscribers who have had a station for 12, 6, 3 months, and so on. In order to fix the idea, let us say that in a certain exchange there have been 20,000 subscribers during 100 days, 25,000 during 140 days and 30,000 during 125 days, then during the year there have been $20{,}000 \times 100 + 25{,}000 \times 140 + 30{,}000 \times 125 = 9{,}250{,}000$ days of service delivered to the subscribers, or there have been what can be called 9,250,000 subscriber-days, i. e., the equivalent of $\frac{9{,}250{,}000}{365} = 25{,}342$ subscriber-years; and the number of connections correspond to this very number, and not to 20,000 nor to 30,000, which is entirely different. Then, to find the number n of connections per subscriber and per year, one must divide

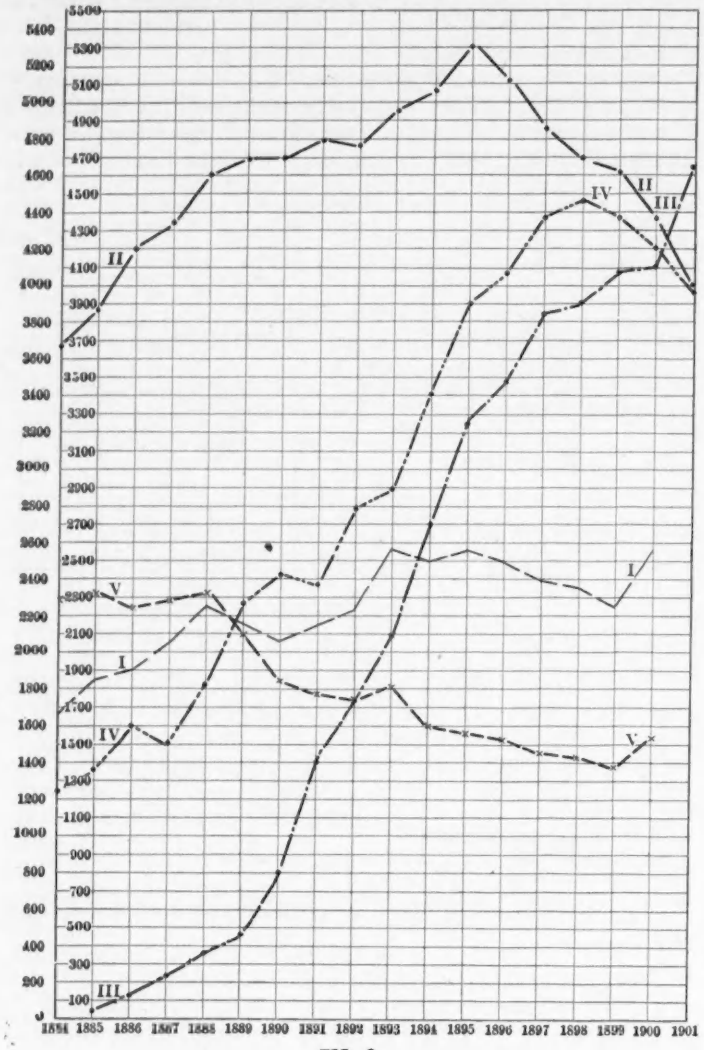


FIG. 2.

I.—Number of exchange connections per subscriber and per year, from the total number of exchange connections and from the mean number of stations per year.

II.—Length in feet of overhead wires per exchange subscriber on January 1st.

III.—Length in feet of underground and submarine wires per exchange subscriber on January 1st.

IV.—Length in feet of wires on extraterritorial and toll lines per exchange subscriber on January 1st.

V.—The number of exchange connections per year and per mile of exchange wires on poles, on buildings, underground and submarine.

the total number N of connections by 25,342.

The exchange manager alone is able to make such precise calculations, and we can in the present case only get a better approximation than usual by using the arithmetical mean between the numbers of stations at the beginning and at the end of the year. A simple glance at the curves I. and II. shows (and it could be understood *a priori*), that if there is only a slight difference between the two curves when the development is a slow one, the case is not at all alike when the speed of growth is fast.

It is by using these arithmetical means that we have obtained the curve I. in diagram No. 2. For each year the average number of connections per station has been got by the division of the total number of connections during the year by the arithmetical mean of stations for the same year. The curve shows that in spite of the belief so often expressed, the number of connections per subscriber and per year does not increase indefinitely as the number of subscribers increase. In the Bell companies of the United States this average number has reached a maximum (1893, 1894, 1895) of 2500 to 2600, and has decreased up to the last year. That is of practical value in various regards. Among other things it leads to the remark that, when ordering a multiple switchboard, it would be a wrong plan to lessen the number of answering jacks per operator, and therefore becomes obliged in any case to increase the number of the sections and lower the operative power of a given room. On the other hand, one would make a mistake if he should conclude, from the diminution in the number of connections per station and per year, that the subscriber suffers from the system of tariff. Should the drawback exist, the enormous amount of subscription contracts which flow increasingly to the exchanges would be a mere dream and not a thing of daily experience. Thanks to the modern system of rates and to the improved service, residence people and other subordinate consumers come to the telephone who formerly abstained from telephoning and let the great firms, wealthy bankers, etc., use the service every minute of the day. It looks really as if there was in the present system of exchange operation some social improvement for the moderately fortunate class of citizens. That the benefit of such a change in affairs is doubtful for the companies or governments which conduct the telephone business may be understood from the curves II. and III. of diagram No. 2, which evidence the increasing mileage of wires per subscriber. If there is but little change in this mean length of overhead wires (3675 ft. in 1884 against 4002 in 1901), with 5314 as a maximum in 1895, the more costly underground conductors show a regular increase from nothing to 4659 ft. If he has not been in close touch with telephone people and telephone business, one can hardly realize what skillfulness has been displayed by hundreds and hundreds to make a success of the industry brought into existence all over the world by Professor Graham Bell's marvelous discovery.

Now we shall direct our attention to curve IV., from which one could conclude that, after a maximum of 4461 ft. the length of interurban wires per subscriber is decreasing without any chance of reaching the said value in the future. This, we feel, would be an erroneous statement, and is at least a too hasty one. Interurban telephony is very likely only at the beginning, and there is not far off a sudden development similar to the one already initiated in urban telephony. The consequence is that, in order to subserve more and more imperative wants, the companies may presently be induced to multiply the interurban lines and increase their relative length per exchange subscriber.

In the same line of study, and in connection with the diminution of the number of connections per subscriber, accompanied by an increase of the mileage of wire, the curve V. is also well worthy of notice. It demonstrates that, since 1888, the operative power of the mile of subscriber's line has been nearly constantly decreasing.[1] The reason is very probably the same as above, that is, the extension of the telephone service to customers who want fewer connections than those of the early times, and whose stations are located further from the business centers of the cities. That will be perhaps partly compensated in the future by a gradual increase in the use of their station by the subscribers as they will grow more accustomed to the telephone. But we think that the conclusion is a rather unexpected one, which deserves a careful consideration when a system of rates is prepared.

Pres. Loubet Praises Submarine Boats.

In his speech to the committee of the Olympic Games President Loubet made an interesting digression on the subject of submarine boats, of which he spoke enthusiastically. He described his trip in a submarine vessel at the time of the Toulon fêtes, dilating on the apparent ease and security with which she was manœuvred. He declared he was convinced that the submarine boat was one of the greatest inventions of modern times, and would prove a powerful factor in naval warfare of the future.

[1] Of course, the mileage of wires used for calculating the data of this curve has been, for similar reasons to those given above, the average arithmetical mean between the mileage at the beginning and the mileage at the end of each considered year.

FIG. 1.—HIGH-POTENTIAL TRANSMISSION LINE SPANNING CARQUINEZ STRAITS.

Spanning Carquinez Straits with a High-Potential Transmission Line.

By R. H. STERLING.

WHEN the Bay Counties Power Company, of California, decided to extend its line from its power houses on the two branches of the Yuba River in the Sierra Nevada Mountains to find a market for its power along the shores of San Francisco Bay and in the city of Oakland, the fact was not lost sight of that such an undertaking would necessitate some features in engineering and line construction that had never before been encountered in long-distance transmission. The extensive market in sight, however, overcame any dread at the thought that there would be 140 miles to cover and miles of mountainous country and long stretches of swamp lands through which the lines would have to be built, and finally, that within 20 miles of Oakland the Straits of Carquinez intercepted the route.

This channel is a deep, swiftly-moving waterway about 3200 ft. wide at its narrowest point, and to cross this was the first serious question for thought. Two methods were available for making this crossing, either to transform from the line voltage of 60,000 that it had been decided to adopt, down to a safe pressure for a submarine cable, and then up again to the initial voltage, or to make an aerial crossing. When the loss in these two transformations was considered it was decided to adopt the latter method, and it is the purpose of this article to describe this feature of the work in the spanning of Carquinez Straits.

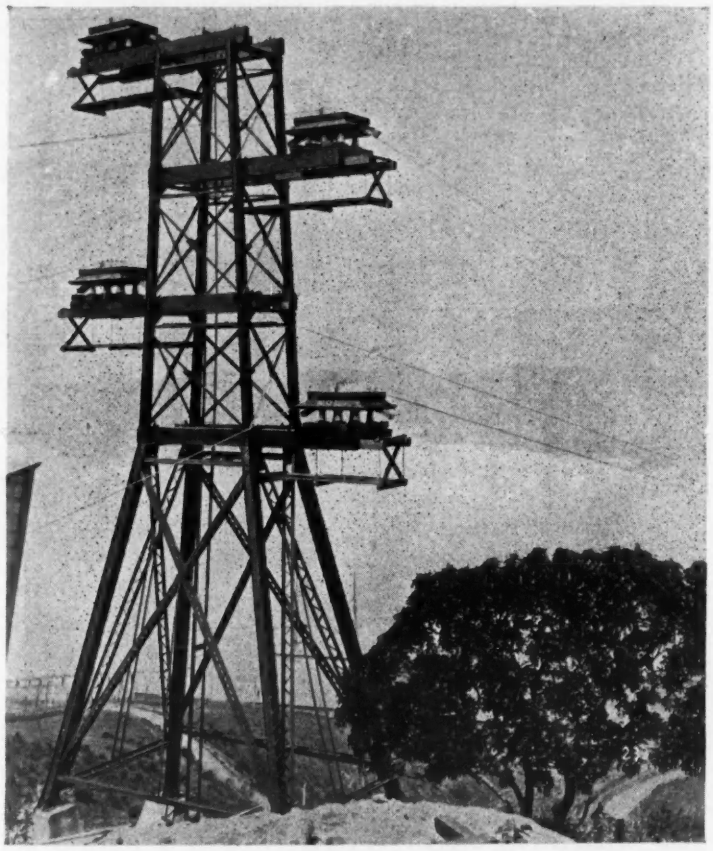


FIG. 2.—SOUTH TOWER, 65 FT. HIGH.

Government requirements called for a clearance of 200 ft. above high water, so that the masts of the tallest vessels could pass safely underneath. An occasional wind velocity of 75 miles an hour occurs at times at this point, so that the features of suspension bridge construction were adopted, and the engineering details were turned over to the Pacific Construction Company, of San Francisco, which has most successfully carried out this undertaking.

Points were located on opposite sides of the Straits where the greatest elevation of land combined with the shortest span was available, and steel towers erected. On the north side a point of land that stood 160 ft. above the water's edge was selected, and owing to the height required from the water at the center of the span and the sag necessary in the suspension to give the required factor of safety in the cable, a tower 225 ft. in height was built. On the south side, to save in height of tower, a point further back and higher up the hill was selected, that only called for a tower 65 ft. in height. This made the span from tower to tower 4427 ft., undoubtedly the longest span of the kind in the world, and when it is considered that the span of the Brooklyn bridge is but 1600 ft. between towers, some

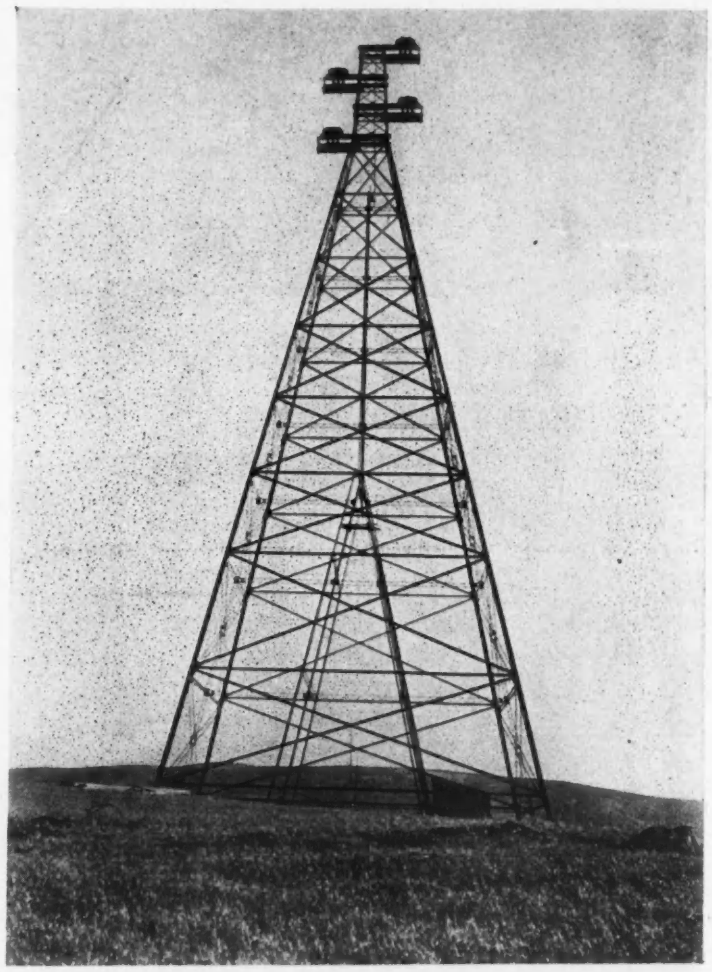


FIG. 3.—NORTH TOWER, 225 FT. HIGH.

comparison can be had. The total distance from one anchorage to the other is 6200 ft.

One of the most important factors in this crossing is the cable, it serving at the same time the purpose of electrical conductor and suspension cable. It is made up of 19 strands of galvanized plow steel wires, forming a cable seven-eighths of an inch in diameter and having the electrical conductivity of a No. 2 copper wire. Four of these cables were stretched so as to have one in reserve for the three-phase system in use. The breaking strain of each cable is guaranteed at 98,000 lbs., and the total weight of each span is 7080 lbs.; with a sag of 100 ft. there remains a factor of safety of 4. The cables, as

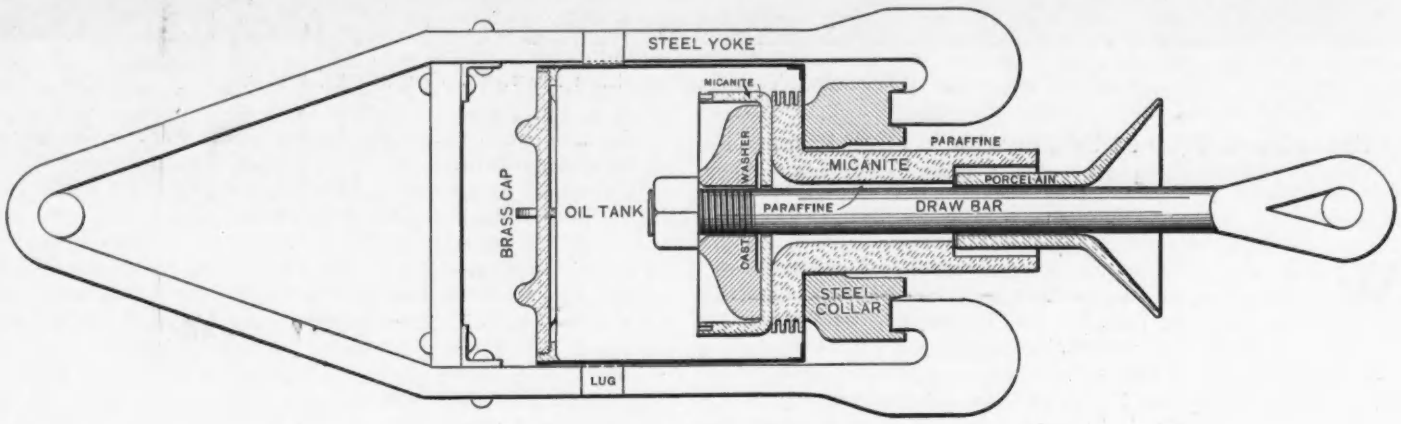


FIG. 4.—DETAIL OF STRAIN INSULATOR.

in suspension bridge construction, are not fastened rigidly to the towers, but pass over them on grooved rollers and thence on to the anchorage at each end, where a strain of 12 tons is exerted for each cable, the bearing down strain on the saddles at the towers being 7000 lbs. for each. The anchorages are composed of heavy concrete blocks embedded deeply in the earth with anchor bolts running through them.

In connection with this work the writer was called upon to design the insulating details for this crossing, a description of which may be of interest.

The insulators used in this crossing are of two kinds, the saddle insulator on the towers, which support the weight of the cables, and the strain insulators that insulate the cables from the anchorages and take the entire pull of the cables. The former are composed of glazed porcelain and made by cementing together with sulphur four separate porcelain shells with a heavy conical steel pin sulphured into the center one. Over this pin is slipped a tapering porcelain sleeve. The weight of one of these insulators is 75 lbs., exclusive of the pin, and measures 17 inches in diameter at the outer petticoat. Six of these insulators comprise a group to support a wooden platform in which are six deep holes that fit down over the main body of the insulators. An eave extends around the edges of the platform to protect somewhat the insulators underneath from driving rain, and a spout is arranged to carry off the accumulated water.

On top of the platform is placed the cast iron saddle proper, which contains five grooved steel sheaves set in line on which the cable rests and allows for any movement due to expansion and contraction. The six saddle insulators are bolted to two heavy timbers extending out 8 ft. from the tower, thoroughly kiln dried, filled and varnished to repel moisture. These timbers present a considerable length of creepage surface, and add in no small degree to the general insulation on the towers, while the saddle insulators themselves have stood 100 and 10,000 volts under test, with one terminal connected on the outer surface and the other to the pin; and added to this, the thick wooden platforms have been boiled in paraffine.

Before taking up the strain insulators it will be stated that in designing the towers the question of the cables swinging together in heavy winds was given careful consideration, and for this reason a horizontal separation of 20 ft. was provided between cables; but since being put into service it has been found that owing to the great weight for so small a wind surface presented there is no appreciable movement of the cables even in the strongest gales.

The designing of the strain insulators presented considerable difficulty. It was first decided to adopt porcelain in their construction, and the failure on the part of the manufacturer to turn out an article that was in any degree perfect mechanically, finally led to the adoption of micanite. This substance has been the salvation of the insulator, for it combines great mechanical with dialectric strength, but, unfortunately, does not possess good surface insulation; that is to say, the shellac which is used to glue the layers of mica together

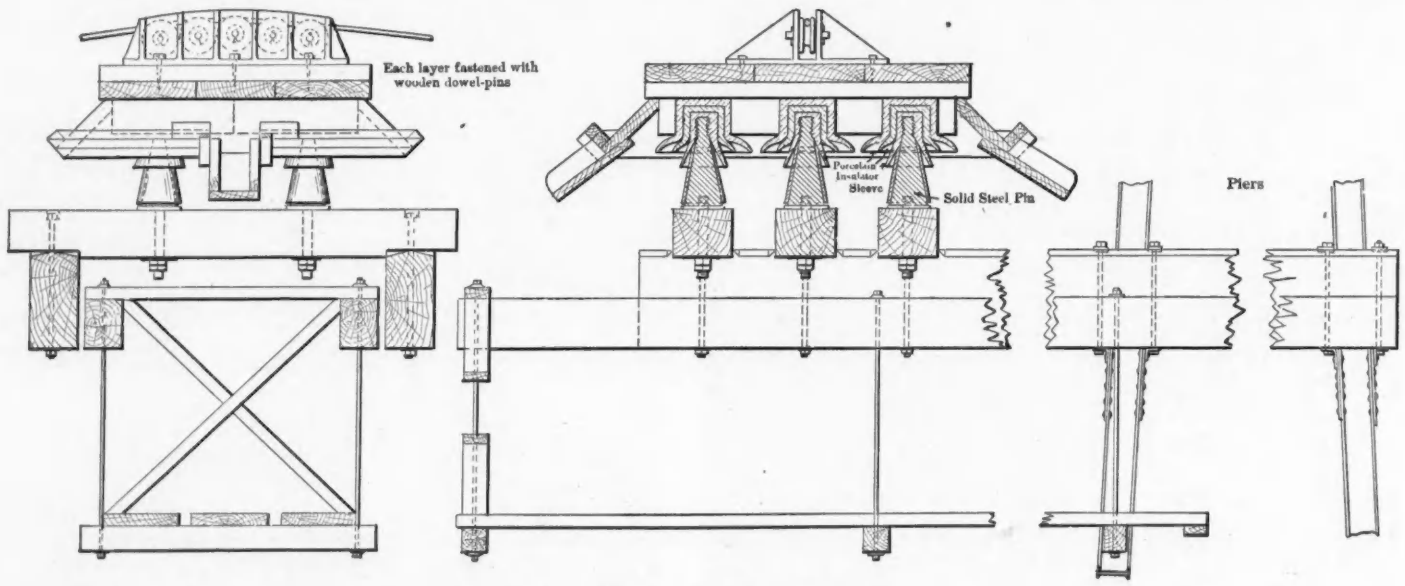


FIG. 5.—SADDLE AND INSULATORS.

FIG. 6.—SADDLE INSULATORS.

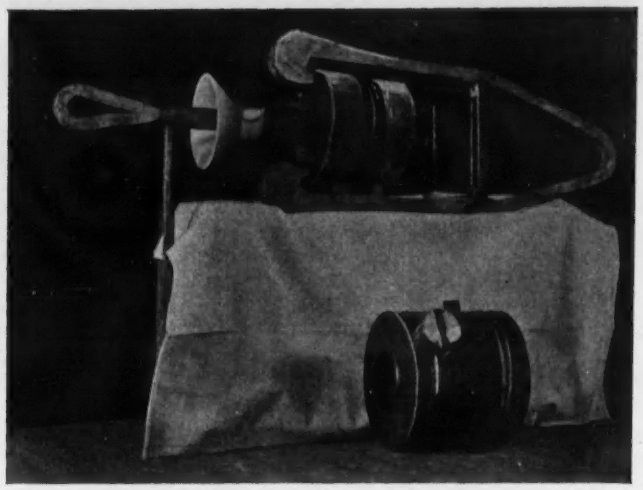


FIG. 9.—STRAIN INSULATOR OIL TANK REMOVED.

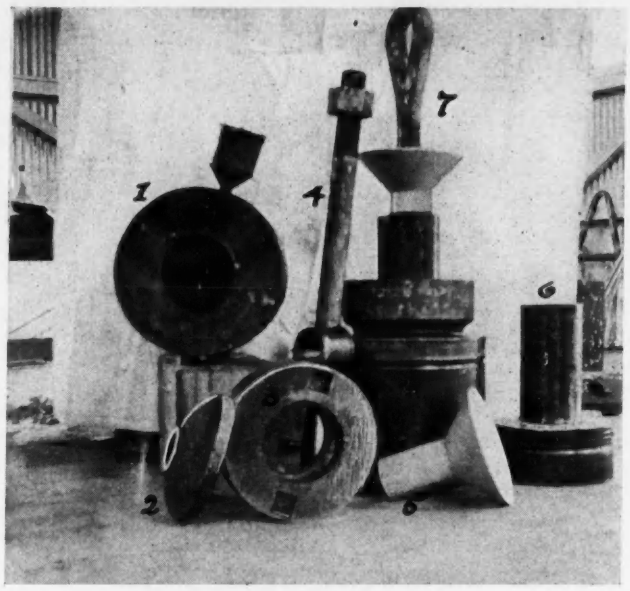


FIG. 7.—STRAIN INSULATOR PARTS.

1.—Copper oil tank. 2.—Washer. 3.—Steel collar. 4.—Draw bar. 5.—Porcelain tube. 6.—Micanite bushing resting on micanite cup. 7.—Complete insulator.

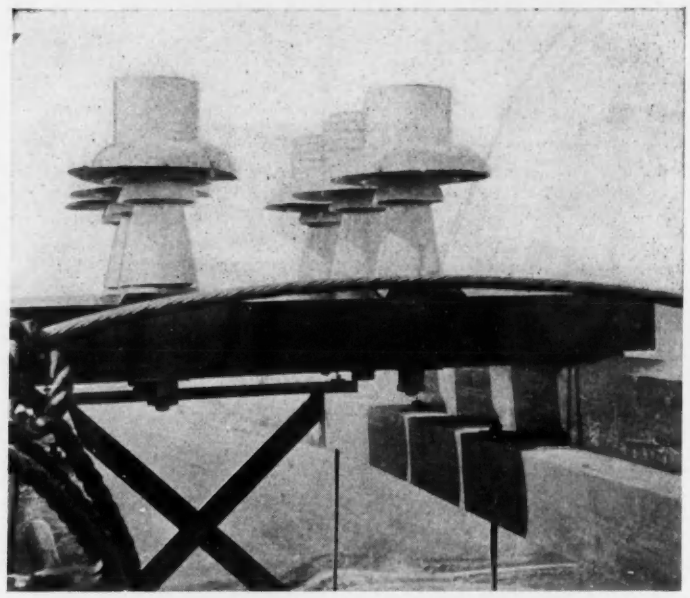


FIG. 10.—SIX SADDLE INSULATORS IN POSITION.

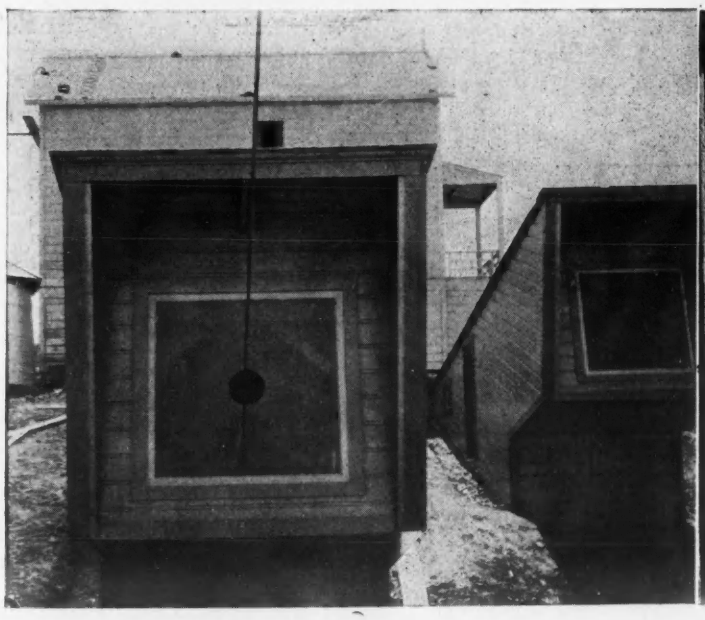


FIG. 8.—ANCHOR HOUSES, WITH CABLES PASSING OUT FROM STRAIN INSULATORS.

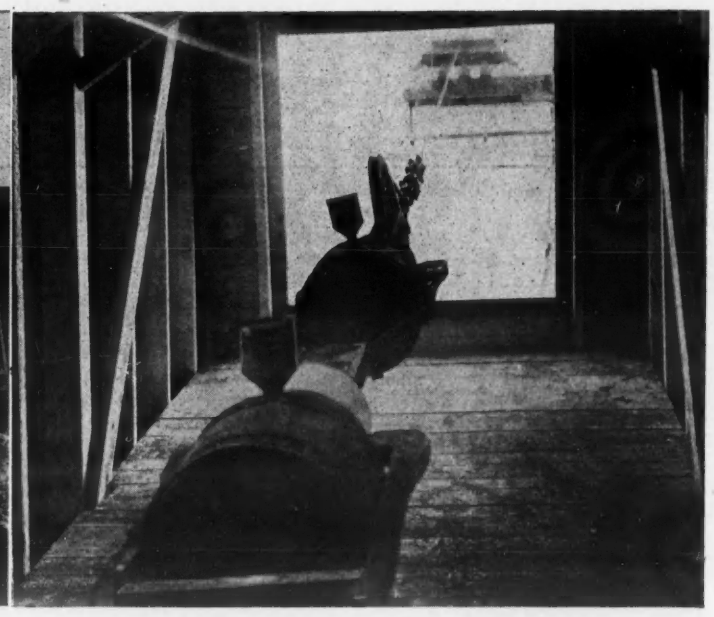


FIG. 11.—INTERIOR OF ANCHOR HOUSE SHOWING STRAIN INSULATOR ATTACHED TO CABLE.

SPANNING CARQUINEZ STRAITS WITH HIGH POTENTIAL TRANSMISSION LINE.

oxidizes and offers a low creepage surface. This defect was overcome by combining with the micanite in this insulator the advantages of oil and porcelain, using the porcelain where mechanical strength was not required.

The detailed sectional drawing and photograph of the unassembled parts will best describe the arrangement of this insulator. The conical porcelain tube here shown gives ample surface insulation between the drawbar and the steel collar corresponding to the difference of potential of the insulator, while the oil inside the copper tank acts in like service as well as to prevent arcing between opposite parts. The grooves shown on the flange of the micanite bush-

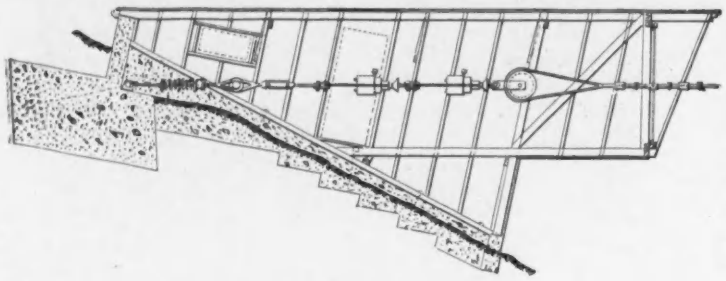


FIG. 12.—ANCHORAGE AND SHELTER.

ings are to increase the length of creepage surface, which, even in oil, is for this voltage not wholly to be relied on unless ample distance is given. The small cylinder or funnel on top of the tank is provided for filling it with oil and to inspect the oil level. While one of these strain insulators has sufficient insulation for the voltage used, it was deemed best to place two of them in series, so in case one gave out there would still remain a protection from grounding the cable.

It will, of course, be observed that no means are provided on the insulators themselves to prevent the interception of leakage to earth due to moisture on the surface, as in the case of the petticoat in line insulators. This, owing to the position in which the insulators are placed, makes such an arrangement impossible; therefore, a shelter was built over each set, and the entrance of the cable through the end of the house provided with a large window of plate glass with a hole 9 inches in diameter through which the cable passes.

Conductors are soldered to the cables just before they enter the anchor houses, and are led to the two sub-stations near by at either

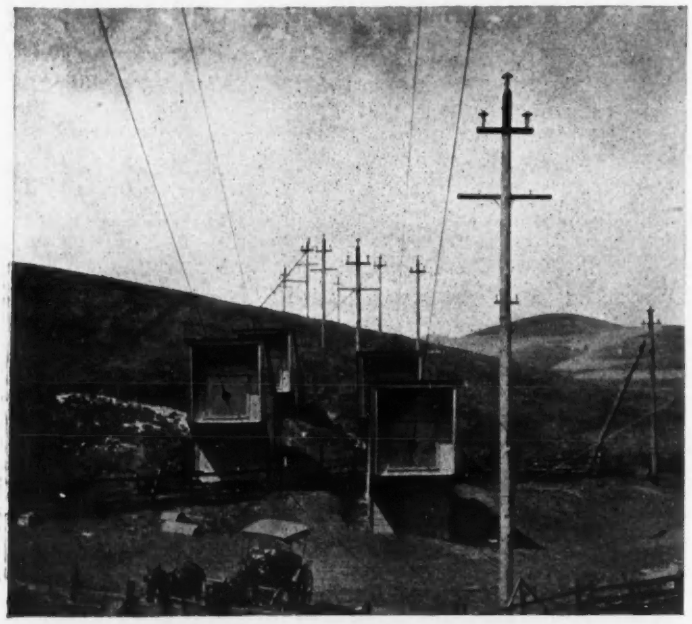


FIG. 13.—GENERAL VIEW OF ANCHORAGE.

end of the crossing; there, by means of high-tension switches, any cable can be thrown out of service and repairs on it or on any of the insulators made, after first grounding the cable to be operated on, since the static effect is quite heavy.

The sub-stations mentioned also contain step-down transformers of 1500-kw capacity for each station from which 5000-volt current is transmitted from five to nine miles up and down each side of the Bay, where it is used for power and lighting at the various towns and manufactories on the way.

The Polyphase Induction Motor for General Power Service.

BY RALPH D. MERSHON.

ALTHOUGH the polyphase induction motor has been on the market for a number of years, and many of them are installed and in successful operation, it is evident from statements made from time to time that few people have a clear conception of its characteristics and applicability. A variety of misconceptions obtain in regard to it, and as a result, the comparisons drawn between the direct-current motor and the induction motor frequently lead to conclusions which are erroneous and much to the disadvantage of the latter.

There undoubtedly exist conditions which can be better met by the direct-current motor, especially the series motor, than by the induction motor, just as there are other conditions which can be better met by the induction motor. There is, however, a middle ground where either motor is capable of doing the work to be done and doing it well, but where the simplicity and reliability of the induction motor and its accompanying apparatus often make it to be preferred, and where the advantages to be gained by employing it will usually outweigh any greater expense which its use may involve. This common field includes that of general power service, in which power is to be supplied in small amounts at numerous points, and usually for work requiring practically constant speed.

The points in regard to which the induction motor is most seriously misunderstood are: *A.* Starting torque. *B.* Speed control. *C.* Disturbance, at starting, to voltage of supply. *D.* Power factor.

A. The starting torque of the induction motor may be as high or higher than that of a shunt motor of the same power. A starting torque equal to two or three times full-load running torque is usual, and it may be made as much higher as is necessary for the work in hand. If abnormal means be in each case resorted to for obtaining a high-starting torque, the limit will be reached sooner with the direct-current motor than with the induction motor.

B. Given a direct-current shunt motor supplied from a single source of e. m. f., and controlled as to speed by a rheostat in the armature circuit; and given an induction motor with slip rings and a rheostat in its secondary circuit—the motors are identical as to speed control. The shunt motor may be started, stopped, reversed, run at high speed or low speed with great torque or little torque; so may the induction motor. If the operator were allowed to see only the rheostat handle and the machinery driven, he would not know whether he were operating a direct or alternating-current motor. The same is true for a motor without slip rings, and controlled by varying the voltage impressed upon it.

In some kinds of work it is desirable that when running at any one of a number of different speeds the motor shall act as a constant speed motor; that is, the speed shall not materially vary with varying torque. This is not the characteristic of any motor under rheostatic control, as under such conditions the torque and resistance, jointly, determine the speed, a diminution of either raising the speed and an increase lowering it. This requirement is usually met in the case of the shunt motor by installing two or more supply circuits of different voltages, fed from separate generators or from separate commutators on the same generator. It may be met in the case of the induction motor with one generator and one supply circuit by so winding the motor that by means of the controller its connections may be changed so as to give it different numbers of poles, a greater number for the lower speeds and a lesser number for the higher ones.

C. An induction motor can be started under load with practically no more disturbance to the circuit than takes place with a shunt motor. An induction motor with a starting rheostat in its secondary circuit starts as does a shunt motor with a rheostat in its armature circuit; and though the disturbance may be slightly greater with the induction motor because of the fact that its power factor is less than unity, the difference with good apparatus and lines well installed is inappreciable. The power factor of such a motor when starting with a given torque is the same as when running with that torque; as the full-load power factor should be 90 per cent or over in a well-designed motor, the power factor when starting a load with full-load torque should be at least as high as 90 per cent. It is true that an induction motor with a "squirrel cage" secondary, and having therefore no moving contacts and no starting rheostat in the secondary, will, under some conditions, produce a considerable disturbance if started under load or run below speed, since the power factor of

such a motor when so operated is not so high as that of a motor under rheostatic control, though at full speed it may be as high or higher; but such a motor, if installed with a knowledge of the facts, is put in with a tacit agreement to such starting disturbance as may have place, in view of the inherent advantages of such a piece of apparatus. If, as often happens, the motor may be started under a light load, the starting of a motor of the "squirrel cage" type will not produce any objectionable disturbance.

D. Contrary to the ideas often held, the power factor has in general nothing to do with the efficiency of an induction motor. It is possible to have a motor with a low-power factor and a high efficiency, or vice versa; in fact, it is comparatively easy to design a motor with a high-power factor and a low efficiency—much easier than to obtain a motor whose power factor and efficiency are both high. As the customer's meter registers only the true power, a low-power factor can affect him only as it may affect the regulation of the circuit feeding his premises.

A low-power factor will, however, affect the company supplying the power:

(*a*) By increasing, for a given amount of power delivered, the losses in the lines, transformers and generator over what they would be with unity power factor, thereby decreasing the efficiency and capacity of the electric system.

(*b*) By increasing, for a given amount of power delivered, the drop in the lines, transformers and generator over what it would be with unity power factor.

As to (*a*), it is evident that the lower the power factor the greater the amount of current required for a given amount of power. It may be safely assumed that with the average induction motor of good design running at half load, the power factor will not fall below .8. It will, in fact, exceed .8 at half load, and at full load and overloads it will be 90 per cent or more, so that the power factor of the average motor operating under average conditions my be safetly taken as .8. By exercising some care in the selection of motors for the work to be done by them so that their average load shall be as near full load as possible, this figure can be very materially increased. If such a motor requires an amount of power represented by 100 amperes at a power factor of unity, when operating at a power factor of .8 it will require $100/.8 = 125$ amperes. If the motor be the only one operating on the lines, transformers and generator feeding it, or if the other apparatus on the circuit be only such as has an 80 per cent power factor, the increased current will mean a loss in the generating and transmitting apparatus corresponding to 125 amperes instead of 100 amperes. The efficiency of the system will be decreased somewhat, and if there be a limit in the allowable loss in the system, the capacity of the generating and transmitting apparatus will be less than with a power factor of unity.

If the motor operates on a circuit which, in addition, supplies other apparatus having power factors differing from .8, the decrease of efficiency and capacity will be determined, not by the power factor of the motors on that circuit, but by the power factor of the circuit as a whole, and usually the combined power factor will be greater than that of the induction motor load. This is a point frequently overlooked.

Suppose that the power factor of the motor load on a circuit is .8, then for an amount of power which with power factor unity would be represented by 100 amperes, there will be required by the motors 125 amperes. If on the same circuit there be a load of incandescent lamps taking the same amount of power as the motors, the lamps, whose power factor does not appreciably differ from unity, will require 100 amperes. It is easy to show that under such conditions the resultant current, instead of being 225 amperes, will be less than 214 amperes, and the power factor will be 93.6 instead of .8.

In most plants doing a general lighting and power business, the maximum load comes at a time when there is a much greater proportion of lights than motors, which results in a high-power factor. At other times in the day—even at that time when the motor load is a maximum—there is usually ample capacity in lines and apparatus, since the total demand in current is then less than that at the time of the greatest lighting load. Under these conditions the question of reduced capacity from low-power factor does not figure. In the case of plants supplying a motor load exclusively, the power factor of a given circuit is, of course, identical with that of the motor load upon it.

This question of power factor might be discussed with reference to the use of synchronous motors or condensers for raising its value. The condenser is constructed to-day for commercial work is not however, always so reliable a piece of apparatus as is desirable, and it is not always convenient or economical from an operating standpoint to employ synchronous motors. The use of either results in an added complication to the system, and it is better to look upon such means of raising the power factor as one to which we may resort if necessary rather than as regular or indispensable part of a polyphase system.

As to (*b*), the increase of current due to lower-power factor will increase the drop in the system, but in addition there will be an increase of drop other than that accounted for by the increased current, due to the fact that, with a given current, the effects of line and transformer reactance and generator armature reaction are greater with a low than with a high-power factor. This may or may not impair the regulation. If the variations in load on a circuit are due to motors going off or coming on the circuit, the regulation will be impaired somewhat by reason of the low-power factor; but if the variations of load are due to variations in the loads on the motors, the regulation may be actually better than if the power factor were high. This is due to the fact that though the power demand becomes greater the current over the line does not increase in proportion to it, and the power factor consequently becomes better with such increase of load.

As regards efficiency, direct-current shunt motors and induction motors are on about the same plane, with a slight advantage in favor of the induction motor as regards efficiency at light loads.

It appears, therefore, that, excepting perhaps some very special cases, the induction motor may be made to fulfill any condition which a direct-current shunt motor will meet, and that for general power work they are on a par so far as flexibility and adaptability are concerned. There remains the question of expense in the two cases, including under the head of expense not only the first cost of the motors, but that of the generators and lines necessary to enable the rendering of satisfactory service.

Where power is to be transmitted any considerable distance, alternating current must be used, and at the end of the transmission there is the alternative of using, for the local distribution, alternating currents and induction motors, or that of regenerating, either by means of rotaries or motor generators, and distributing by means of direct current. In this case the point to be decided is as to whether it is cheaper to install the greater generator line and transformer capacity, if any, required for the induction motor, or to install regenerating apparatus requiring constant attendance and a more elaborate sub-station than in case of static transformers alone. The writer favors the former as being generally cheaper in the end, except in some special instances, and as allowing the use of a type of motor which, while an elegant and efficient piece of mechanism, approaches the simplicity and reliability of a wheelbarrow about as nearly as one could ever reasonably expect a piece of moving electrical apparatus to do.

Where the power is to be distributed at a short distance from the generating station, as in the case of a factory, the increased cost, if any, of the induction motor plant must be balanced against such advantages as can be gained by the use of the simpler and more reliable apparatus—an advantage which, while a great one in most instances, is of less importance in others, and cannot be readily figured in dollars and cents. The decision in such a case must be the result of the best judgment of the engineer based upon his knowledge and experience.

The above discussion ignores the synchronous motor as a factor in general power distribution. Such a motor does not lend itself to general power service. The induction motor may be started, stopped and operated by a novice, and will hang on to its work under conditions which would put any other kind of motor out of service; but the synchronous motor with its starting devices and complicated switchboard arrangements requires an attendant of some experience to start, synchronize and operate, and will not stand up to its work under the difficult conditions which the induction motor will meet.

In addition, unless the synchronous type of motor be given considerable attention during operation, the advantages aimed at in its use will not be realized, since a high power factor, either on the motor or the circuit as a whole, means careful adjustment of field charge for varying load. By careless adjustment of field charge the synchronous motor may become more of a detriment than an advantage to the general service, since each synchronous motor can be made to raise or lower to a greater or less extent the voltage of the supply circuit or even of the system.

Novel Features at Telephone House, England.

THE National Telephone Company, Limited, which controls the whole of the telephone system in the United Kingdom, has recently removed into its new home in Telephone House, a handsome building which has been erected on the banks of the Thames at the corner of the Victoria Embankment and Temple Avenue. The building is 250 ft. by 50 ft. wide, and its front on Temple Avenue runs at right angles to the Embankment. The building is a seven-story one, five being above ground and two under the level of the street. This building takes the place of five separate offices, in which the work of organizing has hitherto been carried on. These are merely the head offices of the company, and have nothing to do with the exchange work or the work of the numerous exchanges in London and throughout the country. The offices of Mr. W. E. L. Gaine, general manager of the company, are in this building, together with the offices of the engineers' staff and the secretarial staff, and it may be said that there are in the whole building employed about 320 people, 20 of whom are typewriters. Special reference ought to be made to the arrangements for communicating with the "typists," as differing from those in most offices where a number are employed who, as a rule, take their dictation directly in the room of the person dictating. In Telephone House, however, the typists never leave the room in which their machines are situated, a small telephone exchange being situated near the head typist's machine. Telephone arrangements with a headpiece similar to those used by the regular telephone girls are attached to each typist's machine. When any of the staff, therefore, desire to dictate letters they immediately put themselves in telephonic communication with the head typist who switches them onto any one of the typists who has the least work to do at that particular moment. In that way there is no time lost in sending for a girl to come from a considerable distance or in going up and down flights of stairs. When a letter is to be dictated it is dictated instantaneously, and a service of messenger boys deliver the letters at intervals to the various departments.

In the basement are contained the stationery stores for the whole country, as the head office in London is the only purchasing department of the whole National Telephone Company. The chief office in every district has no authority whatever to buy as much as a pencil, and all the stationery is distributed from the head office at Telephone House. In this basement is also a small printing shop driven by an electric motor, where much of the regular printing of the company is done. There is also a complete testing shop for the testing of all instruments, before being packed for delivery, and also for the testing of samples of goods on which tenders to supply are made. In the basement also are stored special electrical stores for all the companies, consisting of telephones, condensers, retardation coils, induction coils, etc., and there is also stored in the basement a special emergency stock of everything used in telephone work. The offices in general are light and airy, and little artificial illumination is required in ordinary circumstances. Many of the rooms are also heated both by hot water and ordinary fires, and are connected with a system of ventilation operated by electric fans on the roof.

We may say, in a word, regarding the telephone system of which the building described above is the head office: London is divided into six departments, and has 47 exchanges; and the whole country is split up into 61 districts, each of which is independent of the other, and reports directly to the general manager at Telephone House. In December last there were 988 exchanges throughout the country, which take care of 200, 202 stations or subscribers, with the enormous number of 682,857,864 messages per year. The business of the National Telephone Company is steadily growing in spite of the opposition which is about to spring up in the shape of municipal telephones and Government Post Office telephones, and arrangements have recently been made for the establishing of another large exchange in London which will be operated on the central battery system, the apparatus for which will be furnished by the Western Electric Company, of London. The apparatus at present in use by the National Telephone Company varies somewhat, part being American make, part English and part of Continental manufacture. The National Telephone Company has been in the habit of buying wherever the best market could be obtained, a practice of which it will be hard to cure the average Englishman of intelligence.

At the annual dinner of the company in London on May 17, when over 200 members of the staff were present, Mr. Gaine, who presided, stated that during the year 29,221 subscribers had been added. The business, or number of messages, had increased 15.3 per cent, up to 712,000,000, while the post office telegraphs had transmitted 90,000,000 telegrams, an increase of only 2.88 per cent.

Lord Kelvin pointed out that all subscribers to the post office telephone system would be compelled to get into touch with the National Telephone Company's subscribers. He thought the Government would correct the mistake which they were making, in the future. In the meantime, there was nowhere in the world to be found better appliances than those of the company, which would welcome every improvement, from whatever source.

Telephone House, London.

Cost of Changing Power.

Mr. H. H. Vreeland, president of the Metropolitan Street Railway Company, of New York City, in a recent statement, gave some interesting figures in connection with the operations of that company's system. The value of the plant thrown away by the change from cable to underground trolley on the Broadway, Lexington Avenue and Columbus Avenue lines he places at $6,000,000. The total cost of the installation of the cable system was about that amount, in addition to $10,000,000 for real estate and constructive work on the roads. The installation of the electrical plant has cost another $10,000,000. Last year the conductors on the system collected $15,500,000 in nickels.

Magnetic Attraction in Dynamos Due to the Armature and Field being Non-concentric.

BY EDGAR KNOWLTON.

THE magnetic attraction due to the displacement of the armature or field is important to the dynamo builder, and also to the engine builder, when the dynamo is mounted on the engine shaft. If the armature and field are concentric when first installed the subsequent wear of the bearings will shorten the air-gap on the under side and cause an additional pressure on the bearings. If the gap be smaller at the top than the bottom the attraction will cause a deflection of the stationery member. This is not a very serious matter with machines of small diameter, but with machines of large diameter it should not be overlooked. Many engine builders require that the magnetic attraction be stated for a specified displacement, and it is the object of this article to give a fairly accurate method of calculating this attraction. Certain assumptions will be made which, while not strictly correct, greatly simplify the problem and introduce no serious error.

The accompanying drawing represents the field and armature of an eight-pole dynamo, and shows the paths of the magnetic fluxes. When all the air-gaps of the different poles are equal the fluxes are also equal. Should the air-gaps vary the fluxes will also vary inversely as the reluctances of their circuits. Of course, the reluctance of the metallic part of the circuit varies with the flux, but this is so small a part of the total reluctance that it is neglected for the sake of simplicity.

It may be well to give here a table of the notations which will be used in this article. The densities mentioned are pole face densities in lines per square inch:

d = displacement of the armature.
$V_1 V_2 V_3$, etc., = variations in the air-gap of poles 1, 2, 3, etc.
= practically $d \cos A_1$, $d \cos A_2$, $d \cos A_3$, etc.
g = average normal gap in inches.
a = normal reluctance of one air-gap.
b = normal reluctance of one-half the complete circuit.

$$j = \frac{b}{a} = \frac{\text{ampere turns for one-half the circuit}}{\text{ampere turns for one gap.}}$$

$$h = \frac{da}{gb} = \frac{d}{jg}$$

$$h \cos A_1 = \frac{\text{change of reluctance due to } V_1}{\text{reluctance of one-half the circuit}};$$

and similarly for the other poles.

$\mathfrak{B}_N$ = normal density.
$\mathfrak{B}_1$ = density of the flux from pole 1 to 8 after displacement.
$\mathfrak{B}_2$ = density of the flux from pole 1 to 2 after displacement.
$\mathfrak{B}a$, $\mathfrak{B}b$, etc., = density of poles 1, 2, etc., after displacement.
A = area of pole face in square inches.
N = number of poles.

Referring to the illustration, it is seen that as the displacement takes place the air-gaps below the horizontal are decreased and those above are increased; consequently the attraction of poles 1, 2, 7 and 8 is increased, and the attraction of poles 3, 4, 5 and 6 is decreased. The attraction of pole 1 is the same as the attraction of pole 8; that of pole 2 the same as that of pole 7, etc. In calculating the attraction we substract the attraction of pole 5 from that of pole 1, and to obtain the vertical component multiply the difference by $\cos A$. Since the attraction of pole 8 equals that of pole 1 and the attraction of pole 4 equals that of pole 5, we multiply by 2 and have the resultant vertical attraction of poles 1, 8, 5, 4. Proceeding in the same manner with the other four poles and the problem is completed.

We will now take up the derivation of a formula which may be applied to all cases. The magnetic attraction of any pole before displacement is

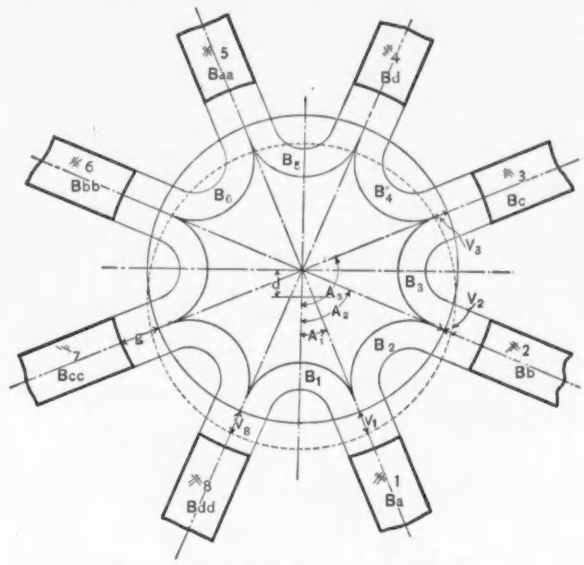
$$P = \frac{\mathfrak{B}_N{}^2 A}{72{,}134{,}000}$$

In order to obtain the attraction after displacement, this formula must be multiplied by the square of the ratio of the density after displacement to the density before displacement. The pole face density of any pole is a mean of the densities of the two fluxes which enter or leave the pole.

We will first consider pole 1. The change in the reluctance of the gap for pole 1 is $\frac{ad \cos A_1}{g}$

The change for pole 8 is $\frac{ad \cos A_8}{g} = \frac{ad \cos A_1}{g}$

The change for pole 2 is $\frac{ad \cos A_2}{g}$



ILLUSTRATING AIG-GAP DISPLACEMENT.

Therefore, the reluctance of the path of the flux $\mathfrak{B}_1$ after displacement is

$$2ja - \frac{2ad}{g} \cos A_1, \text{ and}$$

$$\mathfrak{B}_1 = \mathfrak{B}_N \frac{2ja}{2ja - \frac{2da}{g} \cos A_1} = \mathfrak{B}_N \frac{1}{1 - \frac{d}{jg} \cos A_1}$$

Substituting h for $\frac{d}{jg}$

$$\mathfrak{B}_1 = \mathfrak{B}_N \frac{1}{1 - h \cos A_1}$$

$$\mathfrak{B}_2 = \mathfrak{B}_N \frac{2ja}{2ja - \frac{da}{g} \cos A_1 - \frac{da}{g} \cos A_2} = \mathfrak{B}_N \frac{1}{1 - .5h \cos A_1 - .5h \cos A_2}$$

$$\mathfrak{B}a = \frac{\mathfrak{B}_1 + \mathfrak{B}_2}{2} = \mathfrak{B}_N \left[\frac{1}{2 - 2h \cos A_1} + \frac{1}{2 - h(\cos A_1 + \cos A_2)} \right]$$

The reluctance of the path of flux $\mathfrak{B}_5$ after displacement is

$$2ja + \frac{2ad}{g} \cos A_1$$

and the density

$$\mathfrak{B}_5 = \mathfrak{B}_N \frac{1}{1 + h \cos A_1}$$

and

$$\mathfrak{B}aa = \mathfrak{B}_N \left[\frac{1}{2 + 2h \cos A_1} + \frac{1}{2 + h(\cos A_1 + \cos A_2)} \right]$$

The attraction of pole 1 after the displacement is

$$P_1 = \frac{\mathfrak{B}_N{}^2 A}{72{,}134{,}000} \left[\frac{1}{2 - 2h \cos A_1} + \frac{1}{2 - h(\cos A_1 + \cos A_2)} \right]^2$$

and the attraction of pole 5 is

$$P_5 = \frac{\mathfrak{B}_N{}^2 A}{72{,}134{,}000} \left[\frac{1}{2 + 2h \cos A_1} + \frac{1}{2 + h(\cos A_1 + \cos A_2)} \right]^2$$

The difference between the attraction of the two

$$P_{15} = \frac{\mathfrak{B}_N{}^2 A}{72{,}134{,}000} \left\{ \left[\frac{1}{2 - 2h \cos A_1} + \frac{1}{2 - h(\cos A_1 + \cos A^2)} \right]^2 - \left[\frac{1}{2 + 2h \cos A_1} + \frac{1}{2 + h(\cos A_1 + \cos A_2)} \right]^2 \right\}$$

multiplying by $2 \cos A_1$ (see explanation above) we have as the vertical downward attraction of poles 1, 4, 5 and 8

$$P_{18} = \frac{\mathfrak{B}_N{}^2 A}{72{,}134{,}000} \left\{ \left[\frac{\sqrt{2 \cos A_1}}{2 - 2h \cos A_1} + \frac{\sqrt{2 \cos A_1}}{2 - h(\cos A_1 + \cos A_2)} \right]^2 - \left[\frac{\sqrt{2 \cos A_1}}{2 + 2h \cos A_1} + \frac{\sqrt{2 \cos A_1}}{2 + h(\cos A_1 + \cos A_2)} \right]^2 \right\}$$

Proceeding in the same manner with poles 2, 3, 6 and 7, we have as their vertical component

$$P_{27} = \frac{\mathfrak{B}_N{}^2 A}{72{,}134{,}000} \left\{ \left[\frac{\sqrt{2 \cos A_2}}{2 - h(\cos A_1 + \cos A_2)} + \frac{\sqrt{2 \cos A_2}}{2} \right]^2 - \left[\frac{\sqrt{2 \cos A_2}}{2 + h(\cos A_1 + \cos A_2)} + \frac{\sqrt{2 \cos A_2}}{2} \right]^2 \right\}$$

The quantity $\frac{\sqrt{2 \cos A_2}}{2}$ appears because the density of flux $\mathfrak{B}_3$ does not change; the gap of pole 3 being increased the same amount that the gap of pole 2 is decreased. Theoretically, this is not true, but the difference is too small to take into account.

We then have as the total vertical resultant of the attractions of the poles of an eight-pole dynamo

$$P_t = \frac{\mathfrak{B}_N{}^2 A}{72{,}134{,}000} \left\{ \left[\frac{\sqrt{2 \cos A_1}}{2 - 2h \cos A_1} + \frac{\sqrt{2 \cos A_1}}{2 - h(\cos A_1 + \cos A_2)} \right]^2 - \left[\frac{\sqrt{2 \cos A_1}}{2 + 2h \cos A_1} + \frac{\sqrt{2 \cos A_1}}{2 + h(\cos A_1 + \cos A_2)} \right]^2 + \left[\frac{\sqrt{2 \cos A_2}}{2 - h(\cos A_1 + \cos A_2)} + \frac{\sqrt{2 \cos A_2}}{2} \right]^2 - \left[\frac{\sqrt{2 \cos A_2}}{2 + h(\cos A_1 + \cos A_2)} + \frac{\sqrt{2 \cos A_2}}{2} \right]^2 \right\}$$

Let the value by which we multiply $\frac{\mathfrak{B}_N{}^2 A}{72{,}134{,}000}$ be denoted by C. It can readily be seen that $\frac{C}{h}$ is not a constant for different values of h. In order to determine whether or not any serious error is introduced if we consider that $\frac{C}{h}$ is a constant, the writer has made extended calculations and finds that with the usual values of h that $\frac{C}{h}$ is practically constant.

These calculations also show that it makes but little difference whether the plane of deflection is through a pole or between two poles. It was found that C had the following values:

4 poles $C = 2$
6 poles $C = 4.7$
8 poles $C = 7$
10 poles $C = 9.6$

Above 10 poles $\frac{C}{h}$ is practically the same numerically as the number of poles.

The formula then becomes for

$$4 \text{ poles } P_t = \frac{\mathfrak{B}_N{}^2 A h}{35{,}067{,}000}$$

$$6 \text{ poles } P_t = \frac{\mathfrak{B}_N{}^2 A h}{15{,}350{,}000}$$

$$8 \text{ poles } P_t = \frac{\mathfrak{B}_N{}^2 A h}{10{,}304{,}800}$$

$$10 \text{ poles } P_t = \frac{\mathfrak{B}_N{}^2 A h}{7{,}525{,}000}$$

$$12 \text{ poles and above } P_t = \frac{\mathfrak{B}_N{}^2 A N h}{72{,}134{,}000}$$

This last formula may be changed to a form that may be more convenient for some designs.

Let r = ratio of pole arc to pole pitch,
l = length of pole along the shaft,
d = diameter of armature in inches,

then $A = \frac{l d \pi r}{N}$ and substituting this value of A.

$P_t = \frac{\mathfrak{B}_N{}^2 h l d r}{23{,}000{,}000}$ and if r is a constant it may be still further simplified.

The number of poles considered in the calculations to determine the value of $\frac{C}{h}$ were 4, 6, 8, 10, 16, 20, 24, 32, 48, 72 and 80 poles, The work was carefully checked, and should be reasonably correct notwithstanding the long calculations involved.

Elements of Illumination—XXVI.

BY DR. LOUIS BELL.

IN cases where concentration of light downward along the axis of the lamp is desirable, efficient results are attained by combining lamp and reflector, that is, by shaping the bulb of the lamp itself so that when the part of it nearest the socket is silvered on the outside it shall form an effective reflector of proper shape. Obviously when the lamp burns out or dim the whole combination becomes useless, in which respect the combination is less economical than an ordinary lamp in a carefully designed reflecting shade like the McCreary. On the other hand, the reflector lamps are, on the whole, somewhat more efficient during their useful life, and for general purposes of illumination are much less obtrusive.

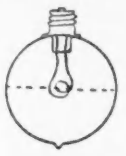


FIG. 1.—SPHERICAL BULB.

In such lamps the bulb, instead of being pear-shaped, is spherical or spheroidal, with the upper hemisphere silvered, the silvering being protected by a coat of lacquer. The filament usually has several convolutions of rather small radius, so as to bring as large a proportion of the incandescent filament as possible near to the center of the bulb. A filament so disposed throws an unusual proportion of the light upwards and downwards when the lamp is mounted with its axis vertical, but, of course, at the expense of the horizontal illumination.

It has sometimes been proposed to use a filament so shaped in an ordinary bulb under the notion of throwing a strong light downwards. Evidently, however, such a lamp throws just as much light upwards toward the opaque socket and the ceiling as downwards toward the tip. Hence there is no gain on general illumination, and no important gain in the downward illumination unless the lamp is mounted with a reflector. Fig. 1 shows in outline a nominal 50-cp spherical bulb lamp with a silvered upper hemisphere, and Fig. 2 the curve of light distribution in a vertical plane. The maximum downwards is about 75 candlepower, while a fair amount of light is thrown out toward and up to 30 degs. from the horizontal. The dotted curve shows the distribution with the silvered bulb, the solid curve the distribution after the silvering had been removed.

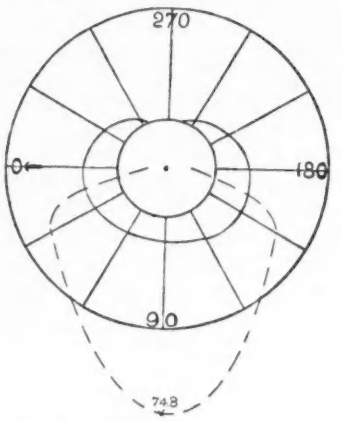


FIG. 2.—CURVE OF DISTRIBUTION IN VERTICAL PLANE.

Fig. 3 shows a common type of reflecting bulb lamp. As usually employed, the lower part of the bulb is ground so as to soften and diffuse the light. The general characteristics of reflector lamps and their field of usefulness have been discussed in a previous paper, so that it is here hardly necessary to say more than to reiterate that whenever a downward light is desired reflector lamps may furnish a most useful means of getting it. Their weak point, as generally made, is a tendency to produce a spotted effect through too great concentration of the light along the central axis. If a projector

effect is the one thing desired silvered bulb lamps are not the best means of getting it, and for their greater usefulness as illuminants they should be so constructed as to give a nearly uniform *hemispherical* distribution. Most of the silvered bulb lamps on the market fail to do this. And it should be noted that since the whole lamp is lost when the filament breaks there is a strong temptation to fit such lamps with a low efficiency filament to give a longer life. A properly designed lamp of this class planned for hemispherical distribution could not fail to be of much use in illumination, and could be produced at a very small extra cost above standard lamps.

FIG. 3.—REFLECTING BULB LAMP.

For various illuminants shades require to be somewhat modified in form, and an enormous variety of shades and reflectors are on the market, of which these described may merely serve as samples. Shading the radiant whatever it may be is a simple matter, and so is the use of a pure reflector (best when of silvered glass) to direct the light in any particular direction. But the commonest fault of powerful radiants, as we have already seen, is too great intrinsic brilliancy, which calls for diffusion, and good diffusion without great loss of light is difficult of attainment, particularly if at the same time there is need of redistributing the light so as to strengthen the illumination in any particular direction.

By far the most successful solution of this troublesome problem is found in the so-called holophane globes, devised a few years ago by MM. Blondel and Psarondaki, and now in somewhat extensive use, both here and abroad. The general principle employed by these physicists was to construct a shade of glass so grooved horizontally as to form the whole shade of annular prisms. These are not formed

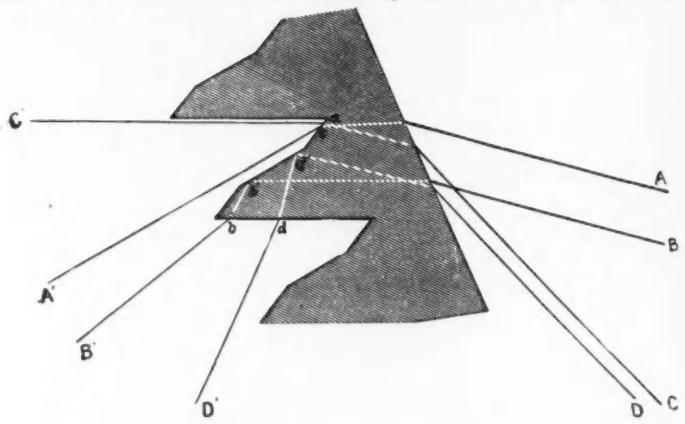


FIG. 4.—HOLOPHANE PRISMS.

as in a lighthouse lens to act entirely by refraction, since in the attempt to bend the rays through a large angle by refraction alone there is a large loss by total reflection. The prisms of the holophane globes are relieved, as it were, at certain points, so that rays which need to be but little deflected are simply refracted into the proper direction, while those that must be greatly bent to ensure the proper direction, are affected by total reflection. This combination of refracting and reflecting prisms in the same structure accomplished the efficient redistribution of the light in the most perfect manner. The diffusion remained to be accomplished, and the means adopted was to form the interior of the globe into a series of rather fine, deep, rounded, longitudinal grooves. The total result is a great reduction of the intrinsic brilliancy, coupled with almost any sort of distribution required, the total loss of light meanwhile being less than in any other known form of diffusing shade or reflector. Fig. 4 shows in detail considerably magnified the structure of the holophane prisms and the combination of refraction and reflection that is their characteristic feature. Here the ray *A* is merely refracted in the ordinary way, emerging with a strong downward deflection from the prism face in the direction A^1. Ray B, B^1 is totally reflected at the face b^1, and then refracted outwards at *b*. *Cb* is strongly refracted and emerges horizontally from the surface *c*, while $D\ D^1$ is refracted at entrance, totally reflected at d^1, and again refracted at emergence from *d*. The net result is to keep in this particular form of prism surface, all the rays turned downward below the horizontal. Obviously other prismatic forms might be employed, which would give a very different final distribution, but the principles involved are the same.

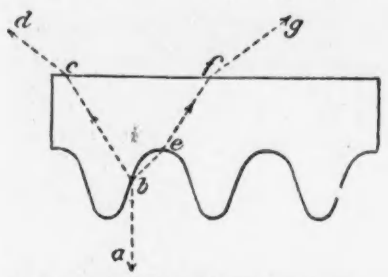


FIG. 5.—DIAGRAM OF INTERIOR FLUTING.

Fig. 5 shows, likewise, on a greatly enlarged scale, the interior fluting, which accomplishes the necessary diffusion of light. The ray *a* is here split up into a reflected component, afterwards refracted, i. e., *b, e, f, g,* and a purely refracted component, *b, c, d.* The shape of the flutings is such as by this means to secure very excellent diffusion at a very small total loss of light. The inner and outer groovings being at right angles produces a somewhat tessellated appearance, but aside from this the surface is quite uniformly illuminated.

These holophane globes are made for all kinds of radiants, but are most commonly applied to Welsbach gas burners and to incandescent electric lights. Evidently the shape of both grooves and globe will vary with the purpose for which the shade is desired, which results in a very large number of forms from which a selection may be made for almost any variety of illumination. It should be noted that these holophane shades both diffuse and redistribute the light in a very thorough manner. Speaking generally, they are of three distinct classes. The first is laid out, according to the general principles of Fig. 4, and is intended to direct most of the light downwards, serving the same end as a reflector, but giving at the same time the needful diffusion without the use of a ground or frosted globe. The general

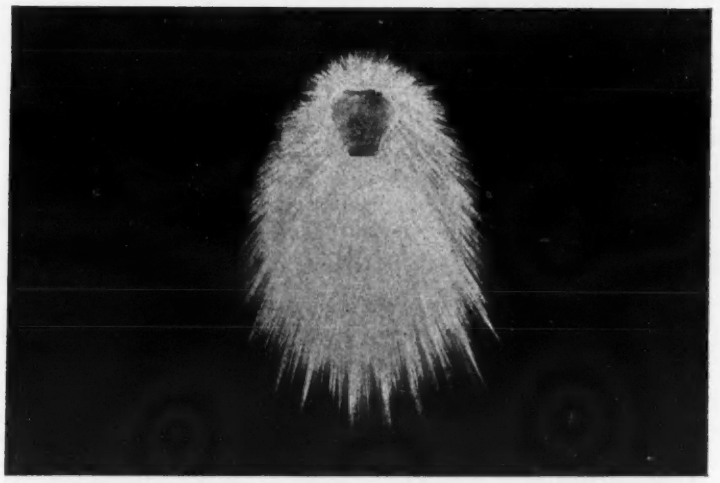


FIG. 6.—DIFFUSION OF LIGHT BY HOLOPHANE GLOBE.

results are strikingly shown in Fig. 6, which gives a very clear idea of what such a globe actually does.

The second class of globes has for its purpose a fairly uniform distribution of the light, mainly below the horizontal, and it is intended for ordinary indoor lighting, where a particularly strong light in any one direction is quite needless. Its effect is shown in Fig. 7. The third general form of holophane globe is designed for the especial purpose of throwing a strong light out in a nearly horizontal direc-

tion, and is shaped so as thus to redistribute the light, putting it where it is most useful for such work as street lighting, large interiors, and the like. The effect produced is admirably shown by Fig. 8. The shapes of globes shown in these last three figures are those intended for mantle burners.

In general, the scheme enables a good degree of diffusion to be secured together with almost any peculiarity of distribution that

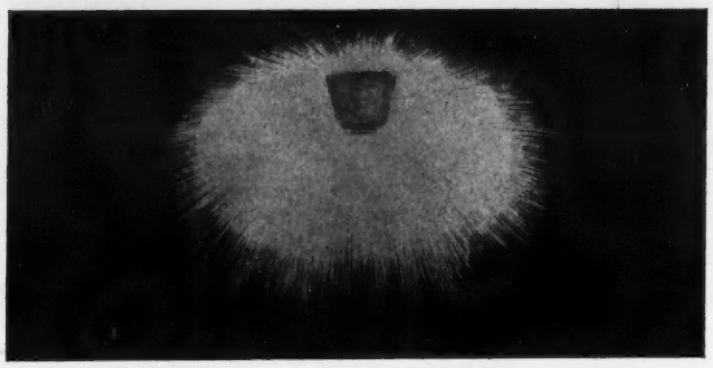


FIG. 7.—MAIN DIFFUSION BELOW THE HORIZONTAL.

could be wanted, and with a degree of efficiency that is unequaled by any known system of shades or reflectors, unless it be the French lighthouse lenses, as will be presently shown by some details of tests.

One does not generally get such a combination of good qualities without certain disadvantages that must be taken in partial compensation. In the holophane system the weak point is dirt. The doubly grooved surface makes an excellent dust catcher, and a layer of dust can easily be accumulated quite sufficient to cut down the efficiency very materially. And, moreover, a hasty dab with a rag does not clean a holophane globe, it must be gone over carefully and thoroughly. When kept clean, the globes actually will do just what is

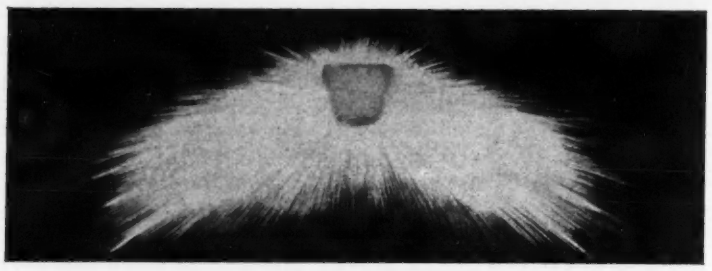


FIG. 8.—HORIZONTAL DIFFUSION.

claimed for them, and are not at all a merely theoretical development superior only on paper, but they *must* be kept clean, and should not be used where they cannot or will not receive proper attention.

This is probably the chief reason, aside from the extra cost, why such globes have not been more extensively used for street lighting, to which their power of redistributing the light in the most useful direction admirably fits them. The results obtained in tests of these globes are so striking as to merit examination in some detail.

Telephone Consolidation in Wisconsin.

Negotiations are under way for the consolidation of all the lines of the Fox River Valley, Wolf River and Little Wolf Telephone companies. This consolidation would make the strongest independent telephone company in this State, and one of the largest in the Northwest. The Fox River Company operates a toll line from Kaukauna to Dale, connecting with the Little Wolf toll lines, and is now building a local system in Appleton, besides having franchises for systems in Kaukauna, Neenah and Menasha.

The Wolf River Company has exchanges of 100 each in Waupaca, New London and Weyauwega, besides exchanges in eleven other towns along the Wolf River. The Little Wolf Company has its main exchange of 580 instruments at Fond du Lac, with exchanges also in Oshkosh, Green Bay, Ripon and 61 other towns in the Wolf and Fox River districts as far north as Shawano, Clintonville and Seymour. The consolidation will be under the name of the Fox River Valley Telephone Company, with headquarters at Appleton.

Storage Battery Auxiliaries—I.

BY LAMAR LYNDON.

IN the application of storage batteries to systems on which the delivered power varies, certain auxiliary apparatus is required except in those cases where the battery is placed at the end of a long feeder to compensate for line drop and also to afford power storage. The function of this apparatus is to vary the e. m. f. at the battery terminals with variations of load, causing absorption or discharge of current as conditions may require.

This apparatus generally takes the form of dynamo-electric machines, the e. m. f. of which acts on the battery circuit to raise or lower its e. m. f., and are known as "boosters." It is the purpose of this article to describe the various booster systems in use and to show the conditions to which each is suited.

Boosters are classified as shunt, series, compound, differential and constant current.

The shunt booster is, as its name indicates, a shunt dynamo driven from any source of power, its armature being in series with the circuit from the dynamo to the battery. This booster is used in plants where the battery does not take up load fluctuations, but is of service merely in carrying the peak of the load, being charged during periods of light load and discharged in parallel with the dynamo when the peak of the load comes on.

The series booster is a series dynamo placed in series with the battery and the two connected across the mains. It is suitable only for power work, and is not now commercially used.

The compound and differential boosters are used chiefly on railway and power systems where the drop due to long feeders is troublesome. They may be used on systems supplying both lights and power, but are not so satisfactory for this work as the constant-current booster.

The constant-current booster is used almost exclusively in buildings where lights and power are to be operated from the same system, and where the feeders are short and the line drop not large. It is also being largely used on electric railway and power work, owing to its cheapness as compared with the compound and differential boosters, and the fact that its regulation can be made better with a smaller machine.

"FLOATING" BATTERIES.

In the foregoing, mention was made of batteries being placed at the end of long feeders for the double purpose of reducing the drop due to heavy currents flowing for a short period over the line and, in a measure, to relieve the power station of fluctuations. In such cases the battery is simply connected in parallel with the circuit, and the charge and discharge are effected by the feeder drop.

When a small load only is on the circuit, the feeder drop is small and the potential at the battery terminals is sufficiently high to send a charging current into the battery. A heavy load causes a greater feeder drop, lowering the potential at the far end across which the battery is connected and the battery discharges, operating in parallel with the generator, and supplying an amount of current proportional to the load, and inversely proportional to the distance of the load from the generator compared with the distance between battery and generator.

A clearer understanding of this subject may be obtained from the following analytical discussion:

Let E_0 = generator e. m. f.
E_A = battery e. m. f.
I_x = current from generator.
I_0 = current supply to load.
r_l = total resistance of circuit exclusive of battery resistance.
r_x = resistance of circuit up to point of application of load.
$r_l - r_x$ = resistance from point of application of load to battery.
R = resistance of battery.

Call the average charging current I_{av} amperes where there is no load on the circuit. Then

$$E_0 - I_{av} \times r_l = E_A + I_{av} \times R \qquad (1)$$

$$\text{or, } E_A = E_0 - I_{av}(r_l + R) \qquad (2)$$

Having determined E_A the number of cells in series is fixed and

$= \frac{E_A}{2} = N$ (3), the relation between I_x and I_0 is established by the following equation:

$$E_0 - I_x r_x - (I_x - I_0)(r_l - r_x) = E_A + R(I_x - I_0) \qquad (4)$$

in which $I_x - I_0$ is the current from the generator to battery at any instant. When $(I_x - I_0)$ is negative (load greater than generator current) the battery is discharging.

Solving for I_x in eq. 4, this is found to be

$$I_x = \frac{E_0 - E_A + I_0(R + r_l - r_x)}{r_l + R} \qquad (5)$$

which shows the generator current under any conditions of load or voltage, when the generator is compounded to give a constant e. m. f.

If the generator be a shunt machine another factor must be included. Take, for instance, a shunt dynamo that gives 550 volts at no-load and 520 volts on full-load of 150 amperes.

The maximum voltage is $E_{max} = 550$. The voltage at any load $= E_{max} - I_x h$, in which h is a constant $= .2 = \frac{E_{max} - E_{min}}{C_{max}}$

Formula 5 becomes

$$I_x = \frac{E_{max} - E_A + I_0(R + r_l - r_x)}{r_l + R + h} \qquad (6)$$

This formula shows that with a shunt machine the generator *current* variation is less than with a constant potential or compound machine, but that the voltage drop is greater at the point of application of the load.

The floating battery has the advantage of simplicity, and acts instantaneously, as it has no time lag, which is always present in a booster, as the latter depends on changes in its magnetization to effect changes in e. m. f.

The variation in voltage required and the fluctuation in generator load are, however, too great to admit of successful operation on any but a railway or power circuit, and generally a proper booster would help the regulation greatly.

SHUNT BOOSTER.

In cases where there are no sudden changes of load, but in which "peaks" occur, the load changing gradually and requiring a considerable time to rise from minimum to maximum, and descend again, the simple shunt booster is applicable. As before stated, this is a simple shunt machine with its armature in series with the battery, and on charge adds an e. m. f. to the generator e. m. f., the resulting voltage being great enough to send a charging current into the battery. When fully charged, the battery, with all end cells cut out, has a potential approximately equal to that of the generator, and when the load peak comes on it is connected in parallel with the dynamo to the bus-bars and assists the latter to carry the heavy load.

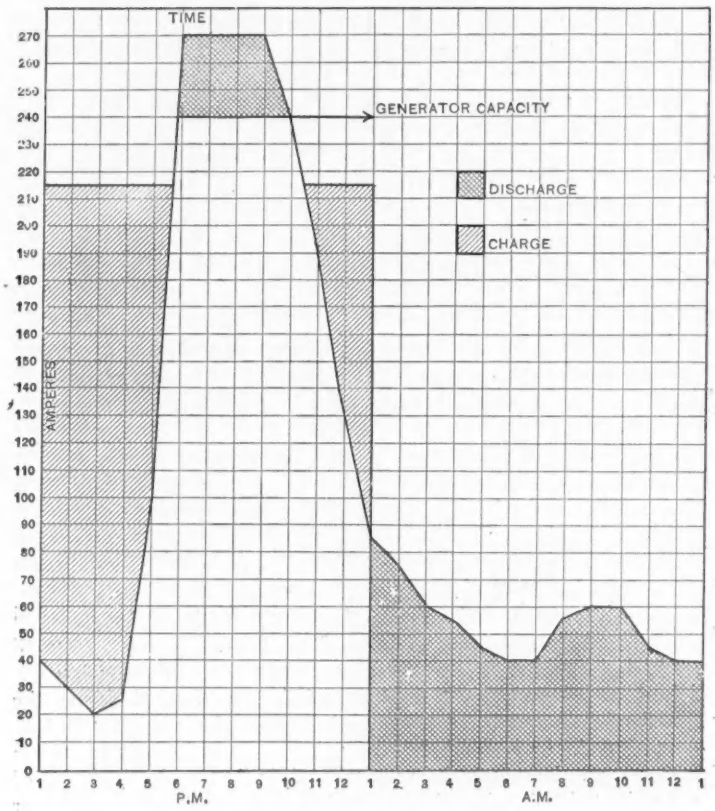


FIG. I.—LIGHT LOAD DIAGRAM.

Usually the battery is made large enough to carry the entire load during periods when the current demand is small. As the battery discharges and its voltage falls the end cells are cut in and the proper potential thus maintained at the battery terminals. Fig. 1 shows the type of load diagram to which this system is suited.

The e. m. f. of the booster may be varied by means of a rheostat in its field circuit, as is usual with shunt machines. Fig. 2 shows the connections of this system.

In Fig. 2, G is the main generator, B the booster, S_1 a double-pole

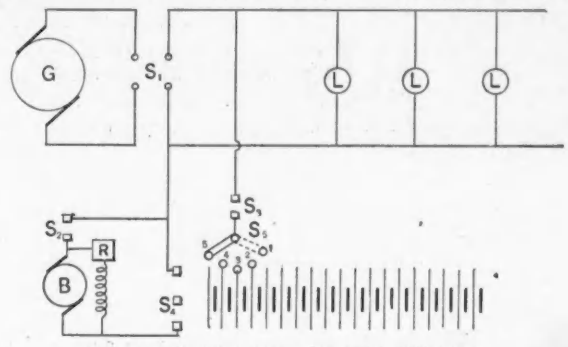


FIG. 2.—CONNECTIONS OF THE SYSTEMS.

single-throw switch, S_2 and S_3 single-pole, single-throw switches, S_4 a single-pole, double-throw switch, and S_5 a battery end cell switch.

To charge, S_1, S_2 and S_3 are closed; S_4 is closed downward and S_5 put on the fifth or last point. Part of the generator current will go into the line and part through the booster into the battery. Charging current is adjusted by means of rheostat R, which varies the e. m. f. of booster.

To discharge, open S_2 and throw S_5 to first point on end cell switch. Next, S_4 should be thrown over to the upper clip. The battery is then in parallel with the generator with all end cells cut out. As the e. m. f. of the battery falls, and cells are cut in by switch S_5. When S_1 is opened the batteries supply the entire load.

The size of the booster required varies with (a) the maximum rate of charge; (b) the voltage of the systems.

As a concrete example, assume a 110-volt, two-wire system, with a load curve such as shown in Fig. 1. The maximum load here is 270 amperes, and the generator capacity 245 amperes. During the period from 5:30 o'clock to 10 o'clock the load on the external circuit exceeds the generator capacity, and this excess must be supplied by the battery. It is also intended that the battery alone shall furnish current from 1 a. m. to 1 p. m.

From the load diagram the maximum charging current is found. This is seen to be 195 amperes. The maximum booster voltage is found as follows:

If Eo = generator voltage, then the number of cells in series $= \frac{E_0}{1.8}$; also $\frac{2.5}{1.8} \times E_0$ = maximum voltage of battery. Let R = resistance of battery circuit, including the booster armature.

Let I_x = current flowing into battery at any time when battery voltage $= E_A$

Then $E_B = E_A + I_x R - E_0$ (7) in which E_B = voltage of booster.

In the case under consideration the total number of cells required is 61. The number of cells required in circuit when the battery voltage is a maximum $= \frac{E_0}{2.5} = 44$. This latter number should be increased, as the voltage of the cells even on slight discharge will fall below 2.5. If 2.3 be taken as the maximum cell voltage on discharge the number will then equal 49. The end cells $= 61 - 49 = 12$. If the normal charge rate of the battery is 40 amperes, assume that it will be one-fourth this amount at full battery voltage, and assume the battery resistance to be 0.2 ohm, then $61 \times 2.5 = 152.5 =$ max. battery voltage, and $10 \times .2. = 2 = \Phi_x R$. Then $154.5 - 110 =$ max. booster voltage $= 44.5$.

As it is sometimes desirable to raise the e. m. f. and charge more rapidly than the normal rate, the booster should always be capable of generating a voltage about 20 per cent in excess of the theoretical. The booster capacity is fixed by knowing the maximum voltage and amperes it will carry.

The power of the motor should be the same as the booster capacity to give rapid charge on rising voltage of battery. Eighty per cent of the theoretical will be large enough an allowance for the machines, as the maximum load endures only a short period. The armature of the booster operating on the system with the load diagram shown in Fig. 1, must be able to carry a load varying from 175 to 195 amperes for three hours. This determines the armature dimensions.

It is to be noted that the shunt booster system is not applicable where sudden fluctuations occur that are great compared with the generator capacity, and that it is not automatic in changing from charge to discharge, this being done by hand. It is, however, simple, does not complicate the switchboard, and fully meets the requirements of systems supplying loads such as shown in Fig. 1.

This type of booster is often installed with a switch to reverse its field and give an e. m. f. assisting the battery to discharge. The field winding may be connected across the bus-bars or battery terminals if desired, the winding, of course, being proportioned to suit the e. m. f. impressed on it. This booster system was patented by H. Ward Leonard, Sept. 2, 1890 (Patent No. 435,700), after an interference by C. O. Mailloux, which was finally adjusted between the parties at issue.

SERIES BOOSTER.

H. W. Leonard's patent of Sept. 2, 1890, also covers the use of series-wound machines as boosters. The connection to the battery is the same as that of the shunt booster—machine and battery in series and connected across the line. With no current flowing into or out of the battery the e. m. f. of booster is zero.

Should the voltage on the line rise because of a decrease of load and a charging current go into the battery, the booster will give an e. m. f. tending to send more current in. The reverse conditions occur when discharge takes place. The series booster acts so as to compound the battery and tends to maintain a constant e. m. f. on the line, whatever the load may be. It depends for its operation on the fact that the generator voltage must rise and fall with the load, and therefore can be used only with a shunt dynamo or its equivalent as the source of supply. This system is suitable only for power work, and is analogous in its operation to the case of the "floating" battery. It is not commercially used, as the compound and differential boosters give better service, under the same conditions.

Charging Facilities for Automobiles.

When the out-of-town use of electric automobiles is discussed the question is often raised in a dubious way, as to the existence of proper facilities for charging and storage of vehicles. We give below an interesting list of the charging plants between New York City and Greenwich, Conn., a distance of possibly 30 miles. It will be seen that there are 10 plants, averaging one to every three miles:

No. 1. West Chester Village, near Morris Park; No. 2. Union Port, electric power house.—Both convenient to Westchester Country Club and Century Golf Club. No. 3. Pelham Manor, near station of N. Y., N. H. & H. R. R., Harlem River branch; convenient to N. Y. Athletic Club, Pelham Country and Golf clubs; at the laboratory of Mr. E. T. Gilliland. No. 4. New Rochelle, Rose and Hugenot Streets, one block from N. Y., N. H. & H. R. R. station, at livery establishment of Mr. Charles H. Coe; vehicles cared for and batteries recharged. No. 5. New Rochelle, electric power house, Webster Avenue. No. 6. Larchmont, Boston Post Road and Chatsworth Avenue, opposite golf links, and convenient to Larchmont Yacht Club; J. Maddox & Sons. This will be a model station for the care of vehicles and recharging of batteries, also the Central office of the company. No. 7. Rye, "Rye School for Riding and Driving," at N. Y., N. H. & H. R. R. station, and the entrance to Apawamis Golf Club; care of vehicles and recharging of batteries. No. 8. Portchester, Portchester Electric power house, after June 1. No. 9. Portchester, directly opposite N. Y., N. H. & H. R. R. station, at livery establishment of Charles H. Benedict; care of vehicles and recharging of batteries. No. 10. Greenwich, after June 1, 1901, near entrance to Fairfield Country Golf Club and at station of N. Y., N. H. & H. R. R., or other locations convenient for residents of Belle Haven.

Scranton's New Independent Telephone Exchange.

By Kempster B. Miller.

WITHIN the past year and a half the Lackawanna Telephone Company, of Scranton, Pa., under the able management of Mr. S. E. Wayland, who is also general manager of the People's Telephone Company, of Wilkesbarre, Scranton's sister city, has planned, contracted for and put into operation a strictly modern telephone exchange to compete with the Bell company in that city. That this exchange was planned and manufactured, and is now being operated by companies in the independent field, will make a description of it more interesting, for it will not only represent what may be considered modern telephone practice of to-day, but will also show the trend of the independent telephone movement in its race with its older and erstwhile stronger competitor.

The exchange was originally planned for 2400 subscribers, but long before it could be installed it was found that this number was inadequate and an order was placed for two additional sections, making the immediate capacity of the original installation 3000 lines. The ultimate capacity of the exchange is 6000 lines. The switchboard is of the relay multiple type, with lamp line signals and central battery, all sources of current, both for talking and signaling, being located at the Central office. The switchboard consists of 10 multiple sections, the equipment of which will be referred to later on.

The exchange is located on the third floor of the Republican Building on Washington Street, directly opposite the courthouse, and the exchange operating room is shown in Fig. 1. The sections now in place are numbered from 1 to 10, while the proposed future extension run up to the full capacity of 6000 lines. This proposed extension will when made necessitate the removal of the partitions between the rooms in the front of the building, which rooms are now used as the general offices of the company. When thus enlarged, the operating room will extend almost the entire length of the building.

The entire central office equipment of the telephone exchange including switchboard, power plant and all inside cables, and also the subscribers' telephones were furnished by the Kellogg Company, of Chicago. The line cables terminate in thirty-two 100-cable heads, arranged in the terminal room on the first floor of the building. The cable heads are of the Cook pattern, and are provided with heat coils and carbon block arresters of the well-known Cook pattern. From the cable heads, which are mounted on iron racks, cables are led through an iron trough or runway, which is suspended 12 inches below the ceiling of the first floor, to the cable shaft, which extends from the first floor to the third floor.

The cables, after leading up the cable shaft, terminate on the line side of the main distributing board. From the switchboard side of the main distributing board, cables are led to the relay frame on which both the lien and cut-off relays are mounted. From this frame cables lead back to the line side of the intermediate distributing frame and from the switchboard side of this latter frame other cables lead to the answering jacks and lamps on the various sections of the switchboard, and still others to the multiple cables running throughout the entire length of the switchboard.

The cables from the cable heads to the main distributing board each have 102 pairs. Those from the main distributing board to the relay have 21 pairs. Those from the relay frame to the intermediate distributing board are 63-wire, each being formed of 21 pairs and 21 single wires to match. The cables from the intermediate distributing frame to the answering jacks and lamps have 63 wires each, and those from the intermediate distributing frame to the multiple runs have 21 pairs each. All of this cable is 24 B. & S. gauge, tinned and insulated with a single wrapping of silk and a single wrapping of cotton, the cotton covering of each wire being colored in conformity with well known color codes. After the wires are bunched in the cables, they are served with a separate wrapping of heavy manilla paper, and are then braided and treated with beeswax.

The connections between the line and the switchboard side of the main distributing frame are made with jumper wire of No. 22 B. & S. gauge, tinned, the insulation being a heavy wrapping of silk and a braid cotton, the whole being saturated in beeswax. This is, of course, in twisted pairs, the colors being red and white. Similar jumper wire is used between the two sides of the intermediate distributing frame.

The function of the main distributing frame is, of course, to change the connection of any line from the outside with any line lead-

FIG. 1.—FRONT OF BOARD.

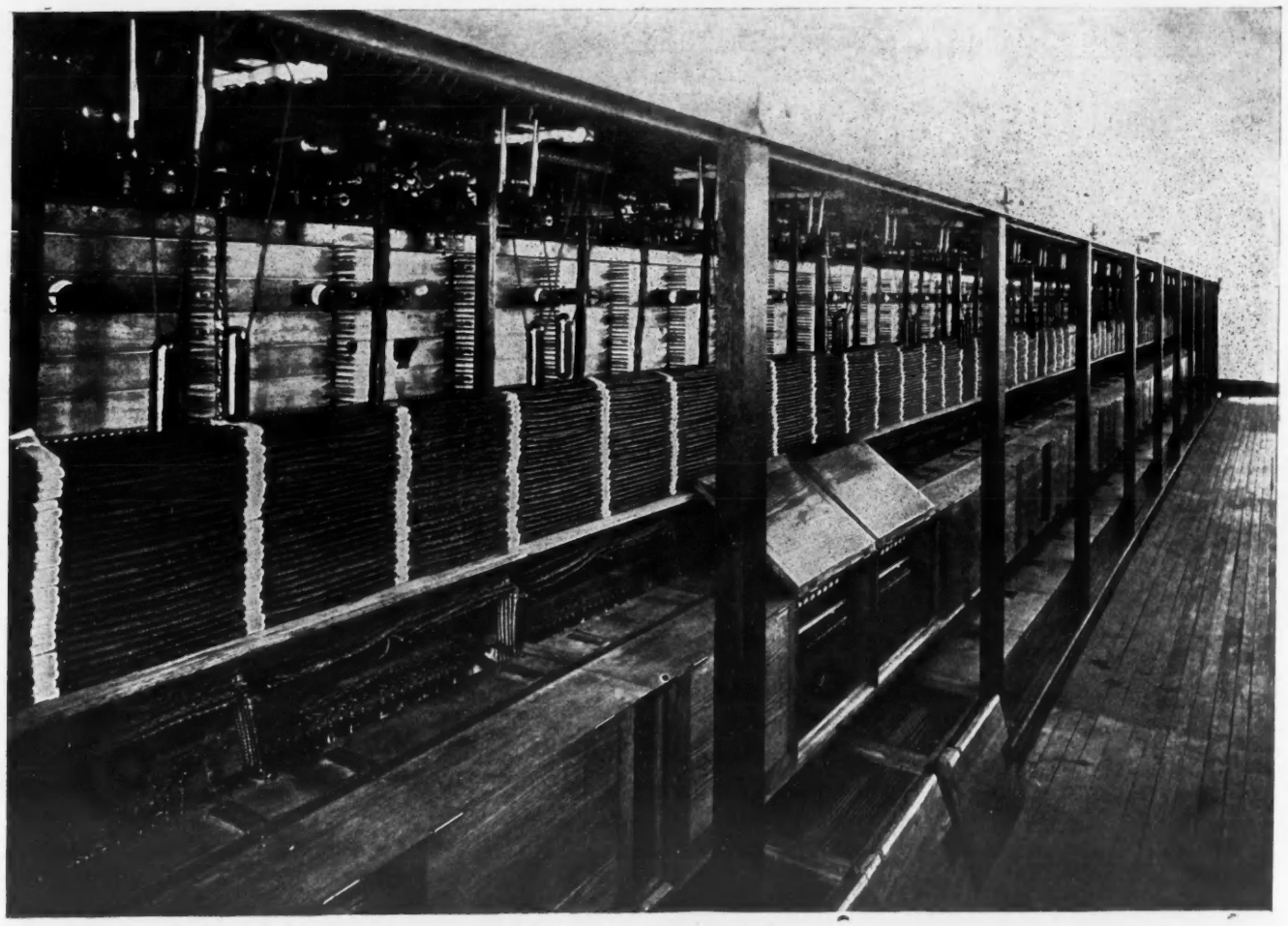


FIG. 2.—REAR OF BOARD.

SCRANTON'S NEW INDEPENDENT TELEPHONE EXCHANGE.

ing to the switchboard. The function of the intermediate distributing frame is to change the relation between the answering jack and line signal, and the corresponding multiple jacks, this latter being for the purpose of the future arrangement or adjustment of the number of answering jacks necessarily handled by any one operator.

The main view of the exchange is shown in Fig. 1, and a front view of a small portion of the board showing the apparatus in greater

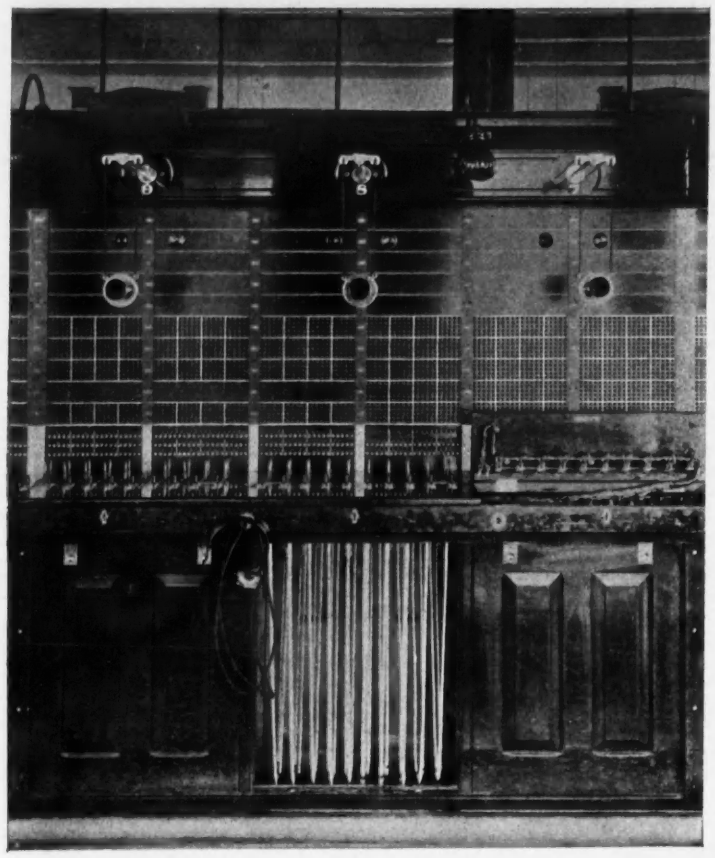


FIG. 3.—A PORTION OF THE BOARD.

detail is shown in Fig. 3. This latter figure shows well the arrangement of the brass foot rails at the bottom of the board, and removable panels under the key-shelves and the key-shelves themselves. Also above the key-shelves are shown the answering jacks with the corresponding line lamps. These answering jacks and lamps are arranged 20 per strip, such lamp being just below the corresponding jack. Above the answering jacks and lamps, but separated by white holly strips are the multiple jacks, and above these are the spaces for the multiple jacks required by future growth. These latter spaces are filled by blank ebonized panels. The multiple jacks are divided by white holly strips into banks of five strips, thus making 100 jacks in each bank. Each section of the board is divided by vertical style strips into six panels, there being two panels for each operator's position and three positions for each section. The arrangement for illuminating the face of the board and the suspension of the transmitters is also clearly brought out.

Fig. 2 shows a rear view of the switchboards, and perhaps gives one as good an idea as it is possible to obtain, without an actual examination of the exchange itself, of the construction of the switchboard frames and the arrangement of the apparatus and the wiring. One of the greatest problems in the planing of a large switchboard is the arrangement for the systematic stowing away of all the cables and wires in such manner as to give easy access to all wire, and more particularly to all portions of the attached apparatus. It is a problem involving the placing of a great number of parts in a minimum amount of space, and at the same time of making all parts readily accessible at a moment's notice. One is reminded somewhat in looking at the rear of a well constructed and properly maintained multiple switchboard of the interior arrangement of a man-of-war, not on account of any similarity in construction, but principally because of the evident pains taken to secure economy of space, and also because of the extreme neatness everywhere apparent.

Under the roof boards of the switchboard may be seen the power wiring and some small apparatus such as operator's induction coils, pilot relays, etc. Below this, and running the entire length of the 10 sections, may be seen the multiple cables, each of which consists of 21 pairs of wire, each pair in each cable being tapped off at each section and connected with the spring jack at that section belonging to the line represented by the particular pair.

The multiple cables after passing through the entire length of the switchboard are led downwardly through the burning section located at the end of the first section installed. The rear view of the cables in the turning section are more clearly shown in Fig. 4, where it is seen that the entire body of multiple cables are bent down to the floor, after which they pass through a horizontal running box to the proper terminals on the switchboard side of the intermediate distributing frame.

Below the multiple cables may be seen the cables leading to the answering jacks and the line lamps. These cables are, of course, individual to each section, that is, each cable leads to one particular group of answering jacks and line lamps and to no other. From each answering jack and its corresponding lamp, the circuit requirements are such that three wires must be lead to the switchboard side of the intermediate distributing frame, and as the answering jacks and their corresponding line lamps are arranged in units of 20 of each, each of such units is connected with a corresponding terminal strip on the intermediate distributing frame by a 63-wire cable; that is, the cable consists of 21 pairs and 21 single wires.

A general view of the relay frame is shown in the left-hand detail of Fig. 6. This frame is of iron, and upon it are mounted in strips of 20 each the line and cut-off relays. The strips upon which these are mounted are of iron, and as the relays themselves are largely constructed or iron, this arrangement affords a fire-proof construction, whereby, even though a single relay were subjected to a heavy current, which might destroy its winding, it is impossible for it to transmit any damage to the other relays.

The relays strip is of heavy wrought iron, having a large number of holes cut in it for the reception of the screws which hold the relays to the plate, and also for the passage of the relay terminals which project through the mounting strip to the rear. All of such terminals which are common, as, for instance, those which are connected to one terminal of the battery, are made common on the back of the strip by short connecting wires soldered directly to these

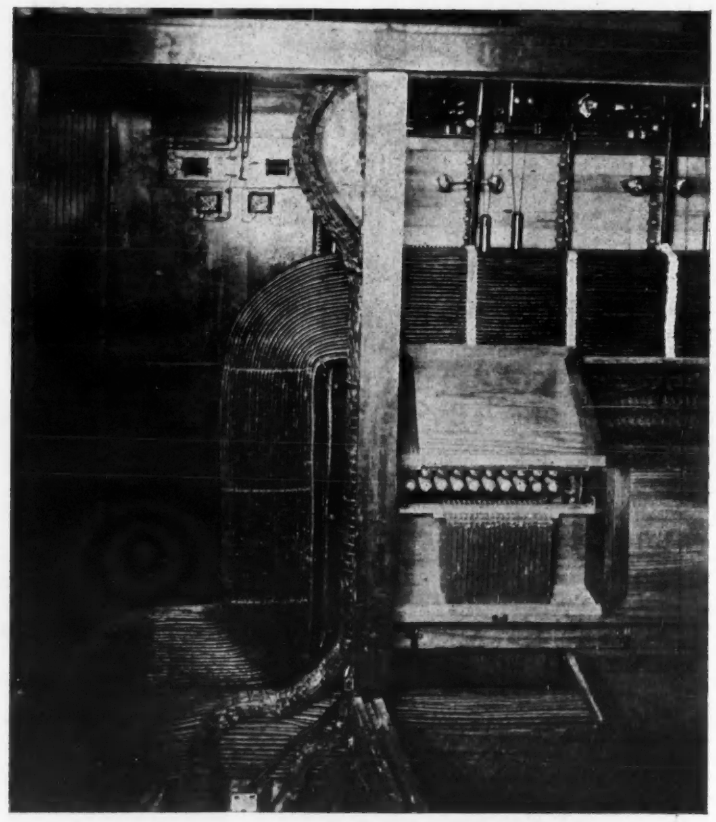


FIG. 4.—CABLES IN TURNING SECTION.

terminals and to the proper common wires running throughout the length of the strips. The other terminals which, in each case, must be maintained strictly individual to the lien represented by their relays are connected through cables to the switchboard side of the

main distributing frame or to the line side of the intermediate distributing frame, as has already been pointed out.

The relays are seen to be mounted in pairs, a small relay alternating with a large one. The large relay in each case is the cut off relay, which is actuated by the operator on plugging into the line to cut off the normally connected line signal, and at the same time to make complete the talking circuit. The small relay is in each case the line relay, the coil of which is placed directly in the line circuit as it

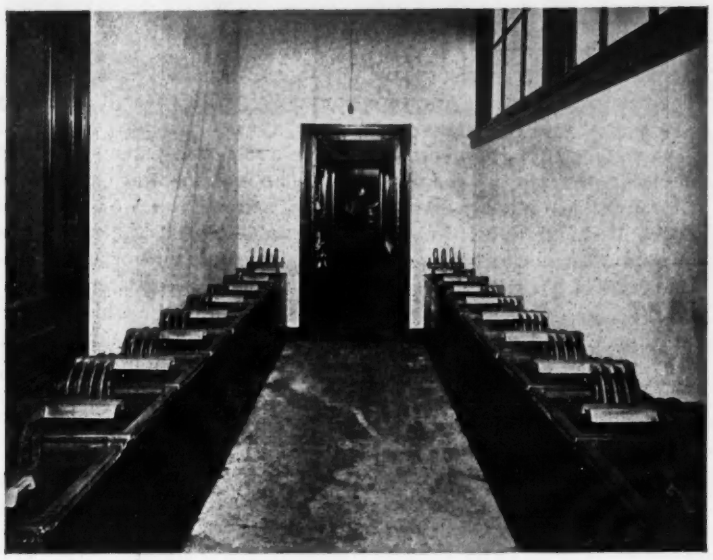


FIG. 5.—STORAGE BATTERY ROOM.

normally exists, and the contacts of which serve when the relay is operating to close the circuit of the signaling lamp.

Each switchboard section is at present equipped with 300 answering jacks and line lamps, although arrangement is made whereby this number may be increased or diminished. As each section is provided with three operators' positions, this makes under the present arrangement an average of 100 subscribers to be served by each operator.

For handling connections, each operator's position is provided with 10 pairs of plugs and cords, with ringing and listening keys and supervisory lamps, there being one supervisory lamp for each plug, or two

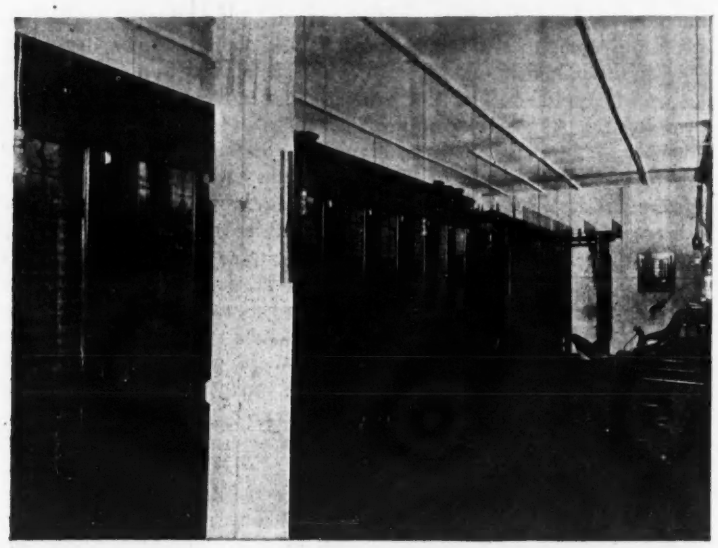


FIG. 6.—RELAY FRAME AND DISTRIBUTING BOARD.

for each pair. The supervisory relays which control the illumination of the supervisory lamps in connection with each plug are mounted in banks of 10 on iron strips fastened directly on the back of the legs of the switchboard section. These relays are so arranged that when a connected subscriber hangs up his receiver, the relay will be actuated, to cause the illumination of the corresponding lamp, but at no other time can the lamp be lighted. As a consequence, it is not until both lamps corresponding to the pair of plugs used in making the connection are illuminated that the operators feels at liberty to pull down the connection.

Both line and supervisory lamps are of approximately one-third candle-power, and are adapted to work on 24 volts, which is the voltage furnished by the two storage batteries.

A 3-cp, 24-volt lamp is located at each operator's position; that is, in the second, fourth and sixth panels of each section, and these are used as line pilots, one of these lamps being illuminated whenever and as long as any line lamp on its position is illuminated. Lamps of the same description, but mounted in the first, third and fifth panels

FIG. 7.—POWER ROOM AND SWITCHBOARD.

of each section are used as supervisory pilots, to show an operator whenever a disconnection is desired at her position. These pilot lamps are merely safeguards against the neglect on the part of an operator to notice one of the small line or supervisory lamps; also being in plain view of the chief operator, they serve as tell-tales to show whether or not the local operators are properly attending to their signals.

In Fig. 5 is shown the two storage batteries for supplying all direct currents for the exchange. These batteries each consist of 10 "American" cells. The tanks are of wood, lined with lead. The capacity of the cells, as at present equipped, are 360 ampere-hours each, but when the full number of plates are added, the capacity will be brought to 840 ampere-hours. The storage battery room has a cement floor, with a drain, and means for artificial ventilation is provided. The discharge leads from the batteries lead direct to the fuse board (Fig. 6), in the power room which immediately adjoins the battery room. From this fuse board wires are led to the individual cord circuits at each section, these wires being formed in 11-pair cables, one cable serving each section. This fuse board is of marble in an angle iron

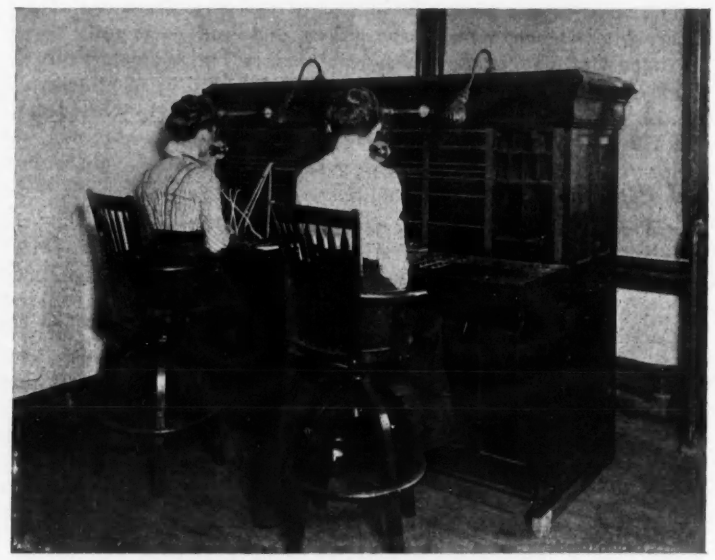


FIG. 8.—TOLL BOARD.

framework, and is shown at the right of Fig. 11, which figure illustrates the complete power plant.

The power switchboard for handling all heavy currents required in the exchange, such, for instance, as the current for the charging and ringing machines and the charging and discharging circuits of the storage batteries, is also shown on the right of Fig. 7. This consists of a marble slab mounted on an iron framework and equipped with a Weston round pattern voltmeter and ammeter, with necessary switches, two circuit breakers, with under and overload attachments, together with the usual full equipment of ammeter shunts and knife switches, and fuses for accomplishing the circuit changes as required.

On the left of Fig. 7 is shown charging and ringing machines. These are mounted on a power table built of angle iron, enclosed in paneled woodwork. The machines are of the Roth type, manufactured in Chicago, and are of the following brief specifications. One ½-hp ringing machine, primary 110 volts direct, secondary 75 volts pulsating and alternating; one ½-hp ringing machine, primary to run off 10 cells of storage battery, secondary 75 volts pulsating and alternating; three 2-hp twin machines for charging, primary 115 volts and secondary 28 volts. These machines are equipped with all necessary starting boxes and field rheostats. By this arrangement, both batteries may be charged at the same time, while the third charging machine may serve as a reserve in case of a breakdown of either one machine. The ringing machine normally runs from 110 volts direct current mains, but if this current fails, the other ringing machine may be run from one of the storage batteries. By this means a temporary shut down of the 110-volt direct-current supply will not cause a corresponding shut down of the exchange on account of lack of ring current.

For handling the toll business in this exchange a separate switchboard section is used. This is provided with a high-wound tubular line signal for each toll line entering the exchange, and also with special toll cords enabling the operators to make a connection through the exchange as from one toll line to another or to connect any toll line through a local toll trunk line with any subscriber in the exchange.

A chief operator's desk is also used, this having two operators' positions, each position having five pairs of cords and plugs, with complement of supervisory lamps and other signals. This board is provided with a modern chief operator's outfit, including listening-in circuits to the various operators' positions on the main board.

The multiple switchboard is built entirely on an angle iron framework, which alone, without the aid of enclosing woodwork, serves to support all apparatus in a rigid manner. The woodwork on the front of the board is mahogany, giving a dead finish, and presents a handsome appearance. The key-shelves are all of five-ply mahogany, the different layers having the grains run in alternate directions in order to prevent warping. The plug-shelves are covered with leather to better withstand the wear and tear of the plugs.

Probably the most striking feature in connection with this exchange is the fact that it is operated on what is known as a "two-wire" multiple system. The circuits of the board have been so simplified that none of the answering or multiple jacks require more than two contacts, and therefore the multiple cables which usually contain three or four wires for each line contain only two for each line. Another advantage derived from the two contact jacks is the fact that two contacts only are required in the plugs, and this makes possible the use of a flexible cord having but two conductors. When it is realized that in a large multiple switchboard one of the greatest items of expense and also one of the most prolific sources of trouble lies in the multiple jacks the reducing of the jack to its simplest form is of manifest importance. Not only is this so from the standpoint of cheapness and freedom from trouble, but the limit of the capacity of the multiple board is determined by the size of the spring jack, or more properly by the closeness with which the spring jacks can be mounted in relation with each other. With the old three, four and five-contact jacks, telephone manufacturers seldom attempted to reduce the size of jacks to such an extent that they could be mounted closer than a half inch apart. It is an easy matter to so reduce the size of a two-point jack as to enable the placing of them with ⅜ inch between centers, and even in extreme cases the distance between centers can be reduced to ¼ inch.

The jacks in the exchange described in this article are mounted on ½-inch centers, horizontally, and 7-16-inch centers vertically. The lamp jacks are ½ inch each way.

Judge Thomas on Independent Telephony.

JUDGE JAMES M. THOMAS, of Cleveland, president of the Independent Telephone Association of the United States, general manager of the United States Telephone Company, the largest long-distance company of the country, has been the central figure of the independent movement, and who is in a better position than perhaps any other person to talk on the operating end of the industry, was asked last week by the Cleveland representative of this paper to present his views on the growth and strength of the independent movement.

Speaking of the history of the independent movement, Judge Thomas stated that the first company to cope with the Bell monopoly commenced business in 1893 in a small town in Kansas. This was immediately after the expiration of the early Bell patents covering the basic principles of the telephone. The movement at once spread with amazing rapidity, especially in the Central States of Ohio, Indiana, Michigan and Iowa. About the middle of 1894 a number of managers of independent companies in Ohio met and organized the Independent Telephone Association, of Ohio. A year later, on June 22, 1895, the Independent Telephone Association of the United States was organized by delegates from seven States. At the fourth annual convention of the association held in Cleveland last year nearly every State and Territory in the country was shown to be represented by independent telephone companies, while the amount invested in the movement was estimated by one authority at $200,000,000.

Speaking of this figure, Judge Thomas said that while he had never prepared an estimate on the subject he thought that $200,000,000 would fall considerably short of the valuation of the entire independent properties of the country. "The Federal Telephone Company alone," said he, "has more than $6,000,000 in cold cash invested in its properties, and besides the long-distance lines of the State, it controls only a small percentage of the total number of companies in Ohio."

Judge Thomas was asked as to the present status of patent litigation. He stated that the expiration of the early Bell patents prior to 1893 had opened the way for the first independent companies. Most of the Edison patents had also expired at that time, and the Berliner patent expired in 1894. The famous Berliner patent case, which has been before the courts for some years, and which was recently settled, was what is known among the independents as the second Berliner patent. The Bell people made an application for a second patent on what was claimed to be the same invention that was patented before. The recent decision of Judge Brown leaves this invention open to the independent field, although it is quite probable that the plaintiffs may decide to appeal the decision to the Circuit Court of Appeals. The Carty patent case covering the method of bridging telephones is now being heard before the Circuit Court at Pittsburg, and the decision will probably be announced in the near future. When this case is disposed of the entire modern telephone system will be open to the world, with the possible exception of some minor patents, more on method than anything else, which can easily be avoided. The switchboard patents are all open, and the highest type of switchboard apparatus, known as the multiple central energy system, is now being built by the independent manufacturers.

Speaking of the extent of the independent toll systems of the country, Judge Thomas said that while several of the more important States are now thoroughly covered with independent toll lines, this branch of the business is still in its infancy. Included in what may be called strictly toll lines, or, more properly speaking, trunk lines, there are probably in the neighborhood of 7000 miles in actual operation. The leading companies and the territories covered are as follows: The New Long Distance Telephone Company covers a territory within a 70-mile radius of Indianapolis, the United Telephone & Telegraph Company, of Bluffton, Ind., covers the territory north of Indianapolis, and the National Telephone & Telegraph Company, of Ft. Wayne, covers that territory. The three companies interchange business and cover the State of Indiana very thoroughly. They operate about 1000 miles of lines. Ohio is covered better than any other State in the country by the lines of the United States Telephone Company, of Cleveland. This company has 2300 miles of line in Ohio alone, connecting about 200 exchanges. The United States Company reaches into Kentucky as far as Ashland and Catlettsburg, into West Virginia as far as Huntington, and has lines extending across Michigan from Toledo to Saginaw and Lansing. The lower end of this line is not yet completed, but in all there are about 150

miles owned by this company in that State. In Michigan there is also the Citizen's Telephone Company, owning about 50 miles around Grand Rapids, and the Union Telephone Company, of Bad Axe, owning about 200 miles in the northern section of the State. These two companies interchange service, and the United States Company has connection with both. The Iowa Telephone & Telegraph Company, of Cedar Rapids, has built a number of lines, and contemplates covering the entire State connecting numerous exchanges already in operation. At St. Louis, the Kinloch Long Distance Telephone Company, which is a part of the independent company in that city, is building considerable territory around St. Louis. It is their intention to cover the whole of Missouri and Western Illinois. This will be a very extensive system when completed, and at present the company has about 500 miles in operation. In Texas, the Texas Telephone & Telegraph Company proposes to connect all the leading exchanges in that State, and already has built about 500 miles of lines. Pennsylvania is being covered by four companies. The Pittsburg & Allegheny Telephone Company, of Pittsburg, has about 100 miles of lines in the neighborhood of Pittsburg. This company has just completed a line to the Pennsylvania boundary, connecting with the United States Company's line, giving through connection from Cleveland to Pittsburg. Eastern Pennsylvania is covered by the Interstate Telephone Company, of Philadelphia, which has about 600 miles in operation. This company is now building a line which will take it into Jersey City. The Union Telephone & Telegraph Company, with headquarters at Erie, has about 300 miles of toll line connecting with Meadeville, Oil City and other important towns. A number of important towns in New York State are being connected by the Consolidated Telephone Company, which, by the way, is a Cleveland organization. This company is building along the lines of the New York Central and Erie railroads, and it is the intention to build clear across the State to connect with New England lines. New England is not yet covered by trunk lines, although the Massachusetts Telephone & Telegraph Company, of Boston, is connecting a number of cities which it is building in that section. A New York organization known as the Telephone, Telegraph & Cable Company has a line connecting New York and Boston with lines touching a number of points on Long Island. The Interstate Telephone & Telegraph Company, of North Carolina, having headquarters at Durham, has several hundred miles of toll lines in that State. The Pittsburg & Allegheny Telephone Company, of Pensylvania, is building toll lines in the vicinity of Baltimore under the name of the Maryland Telephone Company. This company has completed a through line from Hagarstown to Baltimore and then up to Wilmington, Del. It proposes to build on to Philadelphia and also to Washington.

This covers, said Judge Thomas, practically all the main long-distance companies, which correspond to the American Telephone & Telegraph lines of the Bell properties. Of the sectional and local toll lines, no accurate estimate can be reached. The practice of connecting up the farming districts and the small towns in the vicinity of the leading exchanges, is becoming more and more common, and it is this tendency to thoroughly cover their districts with low-priced and satisfactory lines that is accountable for much of the strength of the independent companies. Ohio is undoubtedly the highest example of the independent movement in respect to toll lines. In that State more than 1200 hamlets, villages and towns are now reached by the independent lines. In the majority of cases the counties have been thoroughly connected up by the companies located at the county seats, each company building that section of toll line necessary to connect with the next. The various small systems are given through service by the lines of the United States Company. This plan is being followed in nearly all the States touched by the trunk lines mentioned, and it is only a question of a few years when the entire Eastern and Central sections and much of the Western section will be covered in this manner.

Judge Thomas stated that at the present time it is not possible to talk from New York to Chicago over the independent lines, but he predicts that before very long the entire Eastern half of the continent will be connected by through trunk lines. At the meeting of the Independent Telephone Association of America held last year a committee was appointed to endeavor to make arrangements for through connections with the various long-distance companies, also for traffic rates, so that the receipts from long-distance service could be divided on an equitable basis. It is probable that this committee will have an interesting report to make at the convention to be held in Buffalo.

Judge Thomas expressed himself as averse to the idea that the independent and Bell companies will ever make conciliatory arrangements for the exchange of service. Said he: "If it comes at all, it will be because favorable inducements are made by the Bell people to the individual independent companies, and I feel certain it will not come until competition has forced them to extreme measures. I know of nothing that would lead to such arrangements at the present time. I believe that the future of the telephone business is that there will be two great companies, as in the telegraph business. I do not believe it will be possible, at least for many years, to absorb all of the small independent companies by reason of the somewhat unusual conditions which brought them to life. In nearly every instance the exchanges in small towns were organized by citizens of the towns or surrounding country, who were unable to secure satisfactory service from the Bell people at a reasonable price. They built their exchanges and at once connected up the surrounding districts, thus in a great many cases securing more subscribers than the local Bell company. The investment proved profitable, and now that long-distance service is being given them, the business is increasing and the investment is correspondingly improved. In nine cases out of ten the local stockholders are satisfied with their business, and are inclined to hold on to their properties. Eventually it may be possible to secure the controlling interests in these exchanges by means of an exchange of securities, but I think it would be the work of a lifetime to absorb them absolutely. My opinion is that the toll lines will ultimately come together into some working arrangement, and that the stock of the local companies will be owned about as they are now. Some of the companies will secure control of the larger ones in their territory, but it would not surprise me if in the course of a few years there will be one great independent telephone company that will control the toll lines of the country. The talk of consolidations is in the air at present, and has been during the past year, but so far as I can learn, nothing is being accomplished. They say that the telephone and telegraph companies of the country will get together, but when it comes to working it out, it will be found a difficult propostion."

Judge Thomas was asked as to his opinion of the possibilities of machine telegraphy for night loads. He said: "There are several systems now being experimented upon. I have examined the Delany system, and am satisfied it is a great success. I believe it will be adopted eventually by some of the long-distance companies for furnishing news to daily papers. It would be of immense value for the Associated Press, and would effect great saving in time and cost of sending messages. It seems almost incomprehensible, but it is a fact that you could send enough matter over a single wire in a few minutes to fill one of the big Chicago newspapers. The Delany system accomplishes the work by perforating a roll of paper with a Morse key. You put, say, 40 telegraph operators at work preparing the matter as it is received during the day. They work just as though they were telegraphing, and when the time comes to send the matter to the press, the roll is placed on a machine and transmitted at the rate of 4000 words a minute, being reproduced at the other end in Morse characters. In experiments I have seen the ribbon on the machine stand out straight, 40 ft., the velocity being so great. The Delany device is being experimented with by the Pennsylvania Railroad Company in sending official business, and I believe it is effecting a great saving. Mr. Delany has sold a system to the British Government, and I believe it is to be adopted in connection with their Post Office Department lines. The advantages of such a system for newspaper service can hardly be estimated. The chief feature is that instead of holding the circuits for hours, the news is all sent in a few minutes over a single wire, which saves putting up additional circuits."

Newspapers are rapidly awakening, remarked Judge Thomas, to the advantages of the long-distance telephone in sending messages. At the present time the United States Telephone Company is building a number of special service wires connecting direct with newspaper offices at different points in Ohio. The ordinary instruments are used, and the messages are transmitted as usual by some one who has been trained to talk accurately and rapidly. The messages are received in the newspaper office by a stenographer, written out and handed over to the typesetting machine. It has been found that material for 1200 words can be transmitted in this way in three minutes, and the saving in toll charges is about one-half the cost of telegraphing. This system is bound to grow, but undoubtedly it will eventually be superseded by the machine telegraph."

Speaking of the steps being taken towards standardizing apparatus, Judge Thomas stated that to a large extent this being accomplished by the manufacturers. At the recent meeting of the Ohio association,

a committee was appointed to work in this direction, and it is believed that it will only be a question of time when apparatus will be standard, or nearly so. The advent of long-distance lines is doing much to bring this about, since exchange managers have found it impossible to give good long-distance service unless their instruments are similar to those used by other companies. And the increased business through the long-distance service makes it economy to go to the expense of standardizing.

As to the possibilities for independent exchanges in larger cities not now covered, Judge Thomas stated that inside of two or three years all of the important cities of the country will undoubtedly have the independent service. He referred to the situation in a number of the leading centers. In New York the Knickerbocker Telephone Company recently held a meeting and decided to commence the work of construction at once, the necessary capital having all been raised. The people at the head of the New York company are also interested in the independent company at Boston. In New York about 6000 subscribers have already been secured, and in Boston about 5000. At Boston the company has in operation a small system connecting all the hotels, passenger stations and a number of other points, operating in all about 400 telephones. In Philadelphia, the Keystone Telephone Company has commenced construction work, and has the streets torn up for conduits at the present time. A large number of subscribers have been secured. In Chicago, the United Telephone & Telegraph Company has an application before the City Council, and the matter will probably be settled within a few days. At Cincinnati, the Fitzimmons Telephone Manufacturing Company has held a franchise for nearly two years, and has installed about 1100 telephones reaching all the principle hotels and business houses. The company also maintains about 28 miles of toll lines. At the present time the company is making arrangements to extend its system throughout the entire city, and it also proposes to absorb the independent lines at Covington and Newport. It is also making arrangements for long-distance service by building a line to connect with the lines of the United States Telephone Company. At Dayton, Ohio, the independent company has just secured a franchise from the Probate Court after a fight lasting more than two years. Three companies are working for a franchise in Toledo at the present time. One of them has secured 3000 subscribers.

Louisville, Ky., is just starting to build, and a large list has been secured. Memphis, Tenn., has just completed a fine exchange. Work is just being started on an exchange at Youngstown, Ohio, and the same people are building at Portland, Seattle, Tacoma and several other important points in Washington. The Detroit People's Telephone Company was organized recently by Cleveland people to build in Detroit, and it is probable that the same company will build at several other points in Michigan, with toll lines connecting the various points. Thus far franchises have been refused the independent people in Buffalo, Washington and a few other centers, but it will only be a question of time until the people demand lower rates and better service, and admit the independent companies.

"To sum it all up," said the Judge, "the future of the telephone business amounts almost to a question of how soon manufacturers can supply apparatus and material to supply the villages and towns not now covered. At the present time the business is growing faster than it can be taken care of, and there is hardly a large company in the country but what has many subscribers on the waiting list, simply because instruments cannot be secured to connect them up at once. The work in many towns is being held up for the same reason. The question of finance no longer troubles people who are well known as responsible and experienced promotors. The recent decision on the Berliner patent case has done much toward clearing the atmosphere, and together with the remarkable showing made by some of the companies, has furnished capitalists with the assurance that telephone investments are safe and fruitful. On the Cleveland Stock Exchange; telephone securities are now an important factor of the situation. The bonds of the Cuyahoga Telephone Company have all been sold to a local underwriting syndicate, while the bonds of the Columbus Citizen's Telephone Company were first taken by a syndicate and then placed on the bond market. This company recently paid a good dividend, despite the fact it has been doing business less than one year. Recently Columbus bonds were sold as high as 101. The bonds of the Akron company were recently taken up at popular subscription, being the first telephone securities sold in this way in this section. They were taken up within a few days after they were first offered. Bids on Columbus Citizen's stock have advanced to 75, but none is being offered at any price. Cuyahoga Telephone Company's stock has gone up from 5 to 47 in one year."

Judge Thomas has heard from independent managers in all sections of the country, and the probabilities are that the attendance at Buffalo will be much larger than at any previous convention, especially in view of the fact that it gives delegates an opportunity of killing two birds with one stone. A. M. Kellogg, the well-known Chicago manufacturer who has recently visited a number of important centers in the interests of his concern, states that the independent people everywhere are enthusiastic over the work being done by the association, and says that the attendance will eclipse those of previous meetings. More papers than ever will be presented, and the authors have been selected with great care, each of them being the best possible authority on the subject which he will handle

Observations on Desk Telephones.

BY G. R. JENKS.

FOR many years the Bell telephone companies made an extra charge when subscriber's preferred "nickel-plated desk stands" in place of the regulation wall sets. Nowadays some of them are relaxing and are furnishing these at the same rate. Most of the independent companies, however, still charge extra for the desk stand. A quite usual charge is $10 a year, a sum which would pay outright for pretty much any desk stand on the market. The excuse for the charge is that the long cords are hard to keep in repair, and that the instruments are especially liable to damage from falling on the floor. Sometimes it is urged that the extra convenience to the subscriber should be paid for. The subscriber's time is saved by having the telephone at hand all the time, and time is money.

This is perfectly true, but while the subscriber's time is saved by the device, the telephone companies' time is also saved, and in a much greater degree. Not only is the time of the operator economized, so that they can do more work, but there is the time not wasted while subscribers are getting up from their desks and crossing their rooms to answer calls.

The advantages are most felt at points where the telephone plant is most expensive, and where it is necessary to utilize it to the fullest extent, and at points where the measured service is in effect the direct advantage is shown at once. "Busy" calls are not paid for under the measured system, and as desk telephones do the work more promptly, they are not so often busy. It follows that the more desk telephones there are in use, the fewer are the "busy" calls, and the more the calls that are paid for. It was, therefore, at points where the measured service is used that these desk stands were first given without extra charge.

The independents do not go in much for measured service. Indeed, some of them declaim against it, not seeing or not caring to see that under the "unlimited" system the small users of the telephone are paying the large users' bills. In like manner, they do not see that even under the unlimited system the better their service and the fewer their "busy" calls, the more subscribers they will get. When they thoroughly appreciate this we may expect them to be more logical in the matter of charges for desk stands. Possibly they will go even farther and make a reduction when desk stands are used.

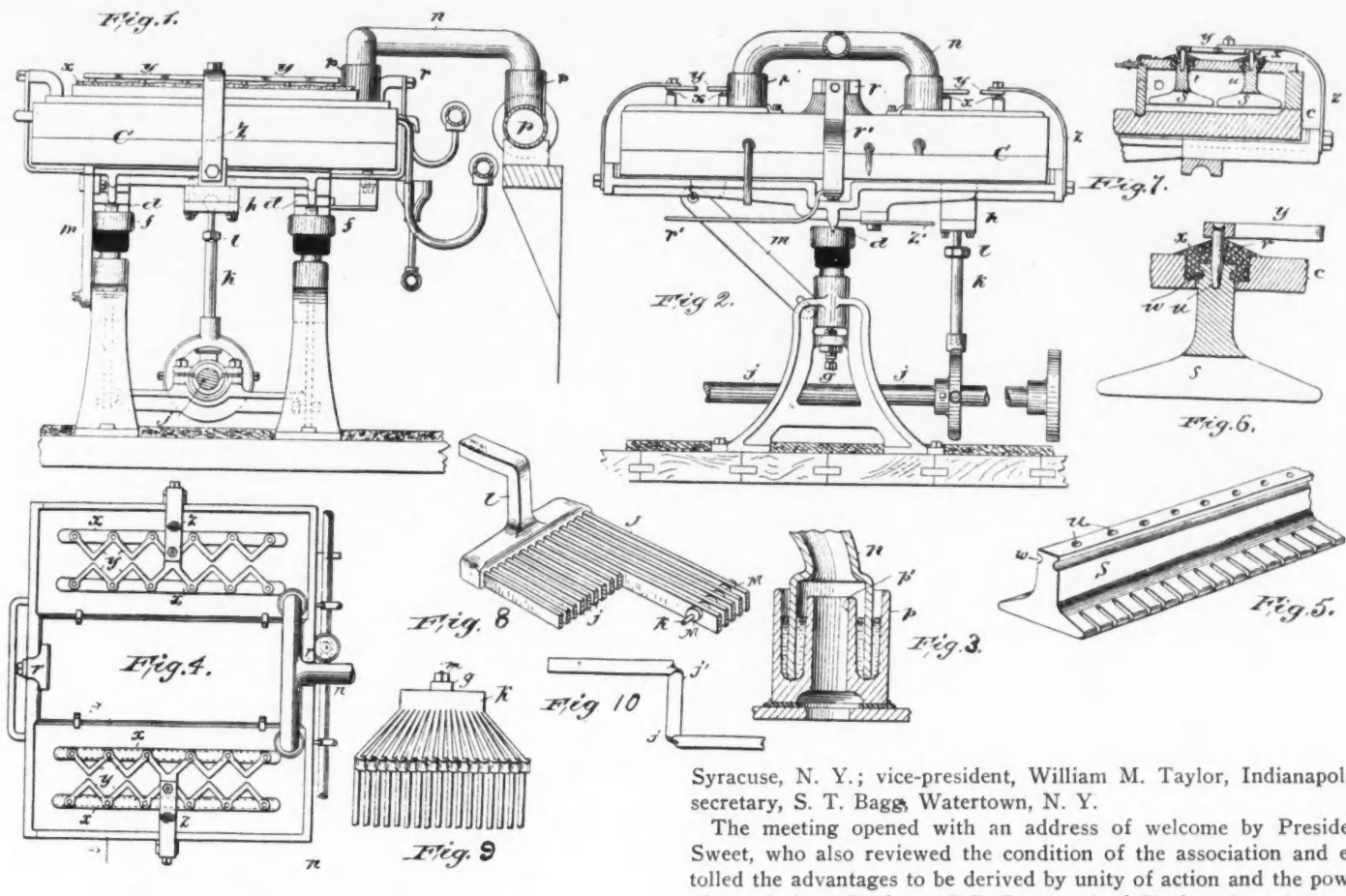
Improved Castner Cell.

Details of the Castner electrolytic cell as modified by Mr. Max Mauran of Niagara Falls, are now available through a series of patents, assigned to the Castner Electrolytic Alkali Company, and issued to Mr. Mauran May 28. The patents cover all details of the cell—the supporting and rocking mechanism, the anode, cathode and gas connections—while retaining the general structure, as shown by the original Castner patents, and first installed in the works of the Matthiessen Company at Niagara Falls. This cell, it will be recalled, is simply a rocking trough divided into three compartments by partitions depending into grooves in the bottom plate, the anodes being located in the external compartments and the cathodes intermediate, while a layer of mercury constituting a bi-polar electrode, flows intermittently between the external and intermediate cells, being charged with sodium in the former and regenerated in the latter. The new cell is distinctly practical, presenting the advantages of

ready adjustability and easy accessibility for repairs, and is provided with simple but effective electrodes and connections.

As appears from the general views (Figs. 1 and 2), the cell body *C* is supported at three points—the two knife edges *d* and the ball and socket joint *h*—each with an interposed insulator. These three supports are independently adjustable, the knife edges by the set screws *g*, and the ball through the split tube *k* and clamping-nut *l*, permitting the cell to be accurately leveled and therefore to operate with the minimum quantity of mercury. All cells of a series are rocked in unison by a shaft *j*, through the intermediary of eccentrics and the ball and socket joints. A wooden safety link *m* insures the cell against upsetting in case of breakage or removal of the eccentric bar. Induction and eduction pipes for the electrolyte and the outlet for the caustic liquor appear at the right of Fig. 1.

The chlorine mains and conduits do not admit of the use of flexible connections with the rocking cell, but are constructed, as shown in detail in Fig. 3, to secure a positive seal without interference with the movements of the cell. A liquid seal *p*, *p'*, is mounted upon the cover of each anode compartment, and a similar one upon the chlorine main *P*. Into these seals extend the three downwardly turned ends of a T-shaped earthenware pipe *n*, latitude being afforded for the necessary side play during oscillations of the cell.



FIGS. 1 TO 10.—IMPROVED CASTNER CELL.

Figs. 4, 5, 6 and 7 show in detail the anodes and connections thereto. The anodes are supported from the cover of the cell instead of being inserted through the side walls as heretofore, and the dangers of breakage and displacement are minimized by substituting for the long series of horizontal pencils, a few relatively large blocks of graphitized carbon having the form of inverted T-bars, the shanks being laterally grooved as at *w* for a supporting Portland cement seal *x*, engaging the grooves and the rabbeted edges of the cover. The flanges are channeled by wide saw keys *s* to permit chlorine bubbles to escape freely. For the electrical connections, the shank of each anode bar is drilled, as at *u*, to receive a series of carbon pins, preferably ordinary arc light carbons coppered and tinned at their exposed ends, and connected together and to the main current leads *z*, *z'*, by a zig-zag leaden strip *y*, soldered to the pencils, and allowing by its form considerable expansion of the parts without snapping the connections or in any way impairing the seal.

Fig. 8 shows a form of cathode consisting of a series of parallel wrought-iron bars *j*, spaced by bolts and washers *K*, *M*, and united by a cast iron head *l*, a close joint free from any interposed chilled surface being secured by the process known as "burning," a considerable quantity of cast metal being poured through the mold to thoroughly heat the ends of the wrought iron bars before any is allowed to solidify. An alternative form of cathode, in which each wrought iron bar is bent twice sharply upon itself, all of the ends being then welded into a homogeneous bar *k*, is illustrated by Figs. 9 and 10. The welded ends are tapped to receive the screw *m* for clamping the negative terminal *g*.

Meeting of High Speed Engine Builders.

The United States Association of High-Speed Engine Builders met in semi-annual convention in Indianapolis, May 28 and 29. Twenty leading manufacturers, chiefly from the States of New York, Pennsylvania, Rhode Island, Ohio, New Jersey, Illinois and Indiana, were present. The present officers are: President, J. E. Sweet, Syracuse, N. Y.; vice-president, William M. Taylor, Indianapolis; secretary, S. T. Bagg, Watertown, N. Y.

The meeting opened with an address of welcome by President Sweet, who also reviewed the condition of the association and extolled the advantages to be derived by unity of action and the power of association. Professor J. B. Stanwood, of Cincinnati, read a paper on "Experience with Throttling Engines," followed by a paper on "The Relationship of Architects and Engine Builders," by S. H. Brubaker, of Indianapolis. "The architect," said Mr. Brubaker, "had to have a training in so many lines that it was impossible for him to be an expert on engines, but what he did know was apparently not appreciated by the engine builder." This paper brought out many criticisms of a friendly nature, and the countercharge was made that the architects often thought that they knew most about the engines, that they were in the habit of putting the engine-room in some secluded nook, so built around that the machinery had to be put into position before the building was completed. It was decided that it would be a good thing if some concerted action be taken.

A secret session was had for the purpose of regulating certain abuses of the trade, and of reaching some agreement, so that in constructing engines for electrical work there may be more uniformity of pattern, thus simplifying the work. The labor question and the control of prices were kept in the background, as the association is largely social in its character, and has no intention of uniting for the purpose of controlling trade or hampering individual effort. The members of the association were entertained at the Columbia Club at a smoker, and also at a banquet at the Denison Hotel. The secre-

tary read a paper prepared by E. H. Burdeck, of Syracuse, N. Y., on "Conditions and Warranties of Construction Contracts." This paper brought out considerable discussion. The convention adjourned to meet in New York next November, when new officers will be chosen. All expressed themselves as having been well entertained by the people of the Hoosier capital.

Telephonic Consolidation in Pennsylvania.

The directors of the Central Pennsylvania Telephone Company, whose headquarters are at Williamsport, and of the Pennsylvania Telephone Company, whose offices are at Harrisburg, have decided to consolidate the two Bell companies. A meeting of the stockholders of the Central Pennsylvania Company, to approve or disapprove of the consolidation, will be held, it is said, July 25, and as the parent company is in control the change will, of course, be made.

Some improvements will be introduced in the Central Pennsylvania Company's territory by General Manager M. H. Buehler, of the Pennsylvania Company, June 1. The consolidated companies will have the advantage of enlarging their long distance revenues in each other's territory, the largest percentage of which now goes to the American Telephone & Telegraph Company. It is reported that the general offices will be moved to Harrisburg, although this is not certain. Whether the present officials of the Central Pennsylvania company will be retained cannot be learned, and probably is not yet decided.

It is stated that the consolidation of the two telephone companies will be in effect within 60 days, and that the stockholders of the Central Pennsylvania, whose capital is $1,100,000 and the par value of whose stock is $100 per share, paying 6 per cent., will receive in exchange for each share of their stock two shares of the stock of the Pennsylvania Company, whose par value is $50 and dividends 5 per cent.

The territory of the Central Pennsylvania Company is from Scranton to Altoona and from the New York State Bradford County line to the Northumberland line; the Pennsylvania Company's territory runs east to Allentown and Bethlehem, including two counties in New Jersey, and northwest to Lycoming County.

R. M. Bailey will continue as president of the Central Pennsylvania; J. E. Wilkinson as treasurer, and John S. Furst as secretary, until the consolidation becomes operative.

The Poulsen Telegraphone Patents.

The issue of June 1 of the *American Inventor,* printed in Washington, D. C., contains a sensational article under the head of "The Loss of a Million," and relating to a Poulsen telegraphone patent. According to the article, it was recently discovered that the United States patent on this invention is invalid for the reason that it was issued seven days beyond the period which may elapse between the grant of a foreign patent and the application for a United States patent. It is stated that this discovery was made when the patent was being investigated by the attorneys of some capitalists, who wished to buy the American patent, and were willing to pay $1,000,000 for the same. It is also stated that the German patent was sold for $250,000. We print below a communication on the subject of the article from Mr. W. A. Rosenbaum:

"In reply to your inquiry as to the article recently published in a journal known as *The American Inventor,* concerning a patent on the Poulsen telegraphone, in which my name was mentioned, I beg to say that nobody has "lost a million." Mr. Poulsen did not find himself with nothing to sell, and the capitalists who wished to take up the manufacture of this invention and who made this "sensational" discovery, have purchased the patents on the telegraphone, nothwithstanding the discovery, and are quite satisfied with their purchase. The alleged imperfection in the patent referred to affects only one of a long list of patents on the telegraphone, and, furthermore, this particular patent is, in the opinion of many who are competent to judge, far from being invalid.

"I do not, as alleged, lay the blame for the late filing of this application upon my foreign correspondents, and while I did inform the editor of *The American Inventor* that I would give him the facts in the matter if he would delay his article until the next issue of the paper, he has, nevertheless, preferred to publish a garbled and incorrect statement in advance, and I, therefore, consider it undesirable to further discuss the matter in the columns of that paper."

Telephone Press Service.

The Federal Telephone Company, of Cleveland, which controls the long-distance lines of the United States Telephone Company, has closed contracts with the New Democrat Publishing Company, of Canton, Ohio; the Crisis Publishing Company, of East Liverpool, Ohio, and other papers of Stark, Summit and Columbiana counties, for special leased wire service for use in distributing news to the different papers throughout these counties. The United States Company is now building the first branch of the line from Canton to Alliance, from Alliance to Salem, and from Salem to East Liverpool, with branches to different parts of the county. The newspapers of the counties mentioned are also making arrangements for through connection with Cleveland, and will receive their news direct from that city as a center of distribution for all news in Northern and Central Ohio.

Although the system has thus far been worked out only on a limited scale, it has shown a marked saving in time and expense over the old method. The correspondent in sending his matter to the different papers in the district, has the lines all connected at one time, thus there is no need of repeating the message a number of times, and it is not necessary to send the material in skeleton form, leaving it to the tender mercies of the telegraph editor to put it into shape. Each newspaper has its stenographer, and the message is simply read to all clients at once, and taken down in short hand.

The saving in telegraph tolls is remarkable. One of the best-informed newspaper correspondents in the State who recently tried the service made the statement that he could send over the telephone within the three-minute limit for $1.20 what would cost him from $3 to $3.50 in telegraph tolls. Experiments have shown that 1200 words can be read off in three minutes—but not often.

The system is attracting much attention in Ohio, and it is understood that a movement is under way for the formation of a press association for handling news reports over leased telephone circuits. The name of this company has not yet been made public, but it is understood to have the sanction of the Ohio association dailies.

CURRENT NEWS AND NOTES.

WIRELESS TELEGRAPHY ON STEAMER.—A Halifax, N. S., dispatch states that the steamship Lake Champlain arrived on May 30, among those on board being Professor Stacy, sent out from England by Professor Marconi to test the wireless telegraph. Tests were made from the steamship to the station at Holyhead, a distance of 60 miles and also from the steamship to Rosslar, a distance of 70 miles. Messages were sent for many of the passengers. It is said that the tests were highly satisfactory.

ELECTRICAL TIDE INDICATOR.—Through a printer's error, the next to the last paragraph in the article on "An Electrical Tide Indicator," in our issue of May 25, is rendered meaningless—the compositor having omitted four lines and joined part of one sentence to part of another sentence four lines below. The first part of the paragraph referred to should read as follows: "The float, which consists of a closed copper cylinder 12 inches in diameter, *actuates the disk* C *through the medium of a sprocket wheel and gear and pinions. The float rises and falls in a well* 14 *inches square with an opening ½ inch in diameter, which serves to minimize the effect of wave action. The disk* (*Fig. 3*) *consists of a piece of hard rubber 8 inches in diameter* and ¾ inch thick, having 120 copper pins inserted near its outer edge." The words italicized are those which were omitted.

ELECTRIC RAILWAY MOTOR CONTROL.—A patent issued May 28 to E. C. Parham describes a method of electric railway motor control designed to retain many of the advantages of the series-parallel system and obviate certain of its defects. Assuming two motors, in starting up the two armatures are in parallel and the two fields in series. In series with the fields is also a starting resistance coil. As speed is attained, the starting coil is gradually cut out, and at the final notch of the controller a resistance coil is shunted across the two fields in series, thereby weakening them. The armatures remain in parallel at all positions of the controller, and in series with the fields. While this method of control is not as economical on the lower speeds as the series-parallel system, it is claimed that on the whole it is more economical owing to the use of resistances at sev-

eral notches in the latter system, which, besides, is seldom used to its greatest advantage owing to ignorant or careless handling. Considerations of first cost and repairs are also said to favor the system patented.

MUNICIPAL ELECTRICIANS.—At meeting of the executive committee of the International Association of Municipal Electricians in Philadelphia the following topics of papers to be read at the sixth annual convention of the association, which will be held at Niagara Falls, N. Y., Sept. 2, 3, 4, were selected and assigned: "The Need and Value of a Set of Rules for Outside Construction," P. H. Trout, Jr., Lynchburg, Va.; "Underground Electrical Construction from a Municipal Standpoint," Edward F. Schurig, Omaha, Neb.; "The Protection of Fire and Police Telegraph Wires from High-Tension Currents and Lightning," W. M. Petty, Rutherford, N. J.; "Improved Storage Battery for Municipal Purposes," J. W. Aydon, Wilmington, Del. A paper will also be read by well-known electrical engineers dealing with the advisability of placing high and low-potential conductors in the same conduits and manholes. The committee consists of Morris W. Mead, president, of Pittsburg, Pa.; John W. Aydon, Wilmington, Del.; Adam Bosch, Newark, N. J.; Frank P. Foster, Corning, N. Y., and Frank C. Mason, of Brooklyn, N. Y. After adjournment, the committee called, by invitation, on Chief Walker, of the Electrical Bureau of Philadelphia, and secured from him a partial promise to appear at the coming meeting of the association, and give the members a talk on "The Lights and Shadows of Municipal Experiences from a Municipal Standpoint." Chief Walker introduced the committee to his successor, John C. Sager, who was already known to the leading members of the association. The committee were entertained by him later at the Hotel Stratford. The Municipal Electricians now have representatives in 110 American and Canadian cities, and are in a flourishing condition. Special arrangements have been made by all the leading railroads, which will permit the members of the association, their families and friends, to attend the association meeting at Niagara Falls, N. Y., Sept. 2, 3, 4, and at the same time visit the Pan-American Exposition, which is being held in Buffalo. Special arrangements for their entertainment have been made by Mayor Butler and Chairman Donohue, of the executive committee of the association. Further details of the programme are in the hands of Mr. F. C. Mason, superintendent of telegraphs, 16 Smith Street, Brooklyn, N. Y.

METALLURGY OF ALUMINUM.—Metallurgical processes which involve the use of calcium carbide as the reducing agent, possess an especial interest due to the fact that they are, in an indirect manner, electro-chemical, for the energy used for the reduction is as truly electrical as though the effect were produced directly by electrolysis instead of indirectly through the medium of the carbide furnace. Hence a discussion of such processes always involves the question of relative efficiencies as between fused bath electrolysis and electric furnace reduction—a question which generally solves in favor of the furnace. This question is raised but not answered by a patent recently issued (May 28) to Mr. Henry Spencer Blackmore, of Mount Vernon, N. Y., for the reduction of aluminum compounds by the reaction therewith of a carbide. Mr. Blackmore finds that aluminum oxide is reducible by aluminum carbide with liberation of the metal of both reacting bodies and in accordance with the equation, $Al_2O_3 + Al_4C_3 = 6Al + 3CO$, the reaction being strictly analogous to that employed by M. Moissan some years ago for the preparation of metallic chromium. If, however, the oxide and carbide of aluminum be employed in the solid state it is found that the aluminum is either volatilized or so distributed through the residual charge as to render its collection impracticable, and accordingly it is proposed to suspend or dissolve the oxide and carbide in a molten bath, which remains inert with respect thereto, and which so reduces the temperature of the reaction and so alters the character of the medium as to permit the liquid metal to be tapped off. Two procedures are described: In the first, a mixture of cryolite and lithium fluoride is fused, and the oxide and carbide of aluminum are alternately added, the reaction occurring readily, it is said, and the aluminum separating freely. In the second, oxide of aluminum is added to the bath and calcium carbide then introduced, the effect being to produce aluminum carbide within the bath by reaction between the cryolite and the carbide of calcium, this aluminum carbide then reacting with the oxide present to yield the metal. The calcium fluoride formed interferes to no marked degree with the operation, and in the early stages serves to promote the fluidity of the metal. Eventually, however, the bath must be regenerated or renewed. Mr. Blackmore is authority for the statement that he has succeeded in producing aluminum by reduction by calcium carbide, on an experimental scale, at an expense not exceeding 7 cents per pound.

LETTERS TO THE EDITORS.

Electro-Chemistry.

To the Editors of Electrical World and Engineer:

Sirs.—I have read with interest the editorial comments in the issues of April 27 and May 18 upon the necessity for further college teaching of electro-chemistry along the lines of the modern German theories, and the views expressed by your several correspondents. It is, of course, true that not all phases of the theory as applied to dilute aqueous solutions can be extended to electrolytes of every kind, but the conceptions of the German school afford the best insight into the changes occurring in an aqueous electrolyte, and it would seem unquestionable that a knowledge of them should be acquired by all dealing or expecting to deal with the subject. That such knowledge should be supplemental to and not in substitution for the engineering training which is the prime need, is obvious.

In the course of several years' connection with the Electro-Chemical Division of the Patent Office I have noted with interest the attitude of working electro-chemists with respect to the modern ideas, and have watched for signs of a reaction of the theory upon the practice. The great theories of the past have proven not only explanatory, but eminently suggestive; that in question affords satisfactory explanation of many matters before obscure, but has not as yet modified the practice of any existing industry to any marked degree.

The Patent Office does not require that an applicant explain his process other than by a clear and full statement of the procedure and the result. It does, however, request that the theory be set forth so far as practicable, and it is worthy of note that the statements furnished by the inventors, one and all, adopt the terminology, more or less correctly applied, of the German school. I can only conclude that they have found these modern conceptions to be the most helpful, convenient and expressive as regards the phenomena noted.

Of late indications have not been lacking that suggestions due directly to the dissociation theory will in time react upon the industries. It has been found that when solutions of a dilution corresponding to complete dissociation are employed for the electrolytic manufacture of pigments, a pronounced change comes over the character of the process, affecting both the purity of the products and the ease with which the electrodes are kept clear; the discovery of the new bleaching agent, potassium percarbonate, seems to have followed directly from observations upon the dissociating effect of water at various temperatures upon the soluble carbonates; considerations of solution pressure now govern to a large extent the selection of a cathode for reduction of nitro-compounds; and the direct applicability of the results of dissociation measurements to the preparation of freezing mixtures is recognized. These few instances are sufficient to show that the modern conceptions cannot be safely neglected by any one having to deal with industrial electro-chemical problems.

CLINTON PAUL TOWNSEND.

WASHINGTON, D. C.

Buying Patents.

To the Editors of Electrical World and Engineer:

Sirs.—Applicants for patents are usually so discouraged by the rejection of claims on a prior patent, that they drop the case, unless arguments and amendments are possible. Sometimes, however, the earlier patent is for substantially the same invention, in which case an expedient may be adopted which is too often overlooked. From the fact that within one week I have been engaged to negotiate the purchase of patents from three different patentees of anticipating patents, I thought it would be well to call the attention of manufacturers, inventors and patent solicitors to the expedient of buying up patents that stand in their way. The earlier patentee may have been unsuccessful in introducing his invention into practice, not because of any demerit of the device, but because he has not had the proper facilities, and as a consequence he is apt to be willing to dispose of his rights at a reasonable figure. On one occasion of note in my experience, the patent upon which claims were rejected was owned by a company which had not paid its State taxes for two

years. That patent, therefore, cost my clients only $1,300. In another instance a company wanted to pigeon-hole a new system, and I sold the United States patents for my clients at $15,000, and the foreign at $15,000, a small sum in comparison with the loss which would have followed by a new competitor in the field. In another case a manufacturer owned a patent, but by manufacturing, he would infringe a second patent. He knew that he infringed, and, therefore, willingly paid me $3,000 for the patent. There are cases where the patents infringed have been bought at a few hundred dollars instead of a few thousand. It all depends upon the lowest figure the earlier patentee is willing to accept. In conclusion, let the applicant for a patent, as a last resort, authorize his solicitor to obtain an offer from the patentee whose patent is cited by the Patent Office as an anticipation of claims. Should the applicant be a manufacturer or associated with capital, and able to afford an investment, he may conclude that he is fortunate if the patent is not yet introduced, and is not heaping up piles of money to the inventor.

New York City. Edward P. Thompson.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers

Polyphase Working.—Eborall.—An abstract of his third lecture on this subject. He dealt with synchronous motors. A polyphase synchronous motor can be started unloaded partly by virtue of the eddy currents produced in the pole pieces and partly as a hysteresis motor; but it takes two or three times the full-load current to get the motor up to speed of synchronism by this means. Thus when synchronous motors of a large size are used it is desirable to run them up to speed with small induction motors, or in the case of motor-generators to start up if possible with the direct-current machine as a motor. He discussed the variations of the exciting current and the V-curves of synchronous motors. He referred to the regulation of the direct-current voltage of rotary converters by varying the impressed voltage on the slip-rings by connecting in circuit a choking-coil arrangement. This inductive regulator consists of a shunt and series winding one of which is movable to vary the distance between them and consequently the inductance. The regulation can be done quite automatically, however, by compounding the field-magnets of the converter and profiting by the properties of the V-curve. As the current increases, the machine is over-excited, the leading current is increased, and, acting in the opposite direction to the lagging effect of the circuit, increases the voltage. He dealt at some length with the question of hunting. Unlike the generator, where a star connection is preferable, the transformer should have a mesh connection when possible, for the simple reason that with mesh connected coils the set is not wholly broken down should one of the coils fail. He was emphatic in his advice that wherever lighting work is to be done, three-phase transformers should be used in preference to combinations of single-phase transformers, which latter is the American practice. In the three-phase transformer the return path of the flux is through the other two coils, with the result that every transformer acts as a balancer. It is also the cheaper to make, up to 100 kilowatts. In the form in which the three-phase transformer is made in continental Europe, the reluctance is not the same for each of the three magnetic circuits, and hence the no-load current is not the same in each phase. All this amounts to in practice is that where several transformers are used care should be taken to arrange them that the larger currents are not all put in one phase, so as to balance the irregularity. As regards construction, he does not favor the shell type, and prefers a butt joint at the yoke (instead of lapping), on account of the facility it gives for replacing a burnt-out coil.—Lond. *Elec.*, May 17; *Lightning*, May 16.

Lights and Lighting.

Miners' Lamps.—Walker.—The conclusion of his Brit. Inst. Elec. Eng. paper on "Electrical miners' safety lamps." He gave figures of the cost of working of the Sussmann lamp. The figures relate to a batch of 600 lamps in use at the same colliery, but used in three shifts by three sets of men, working at different portions of the 24 hours. The total running cost was 16 cents per lamp per week, against 4 cents per lamp per week, with the old oil lamp. The percentage of failures of lamps which were taken into the pit was, when he left the colliery 0.25 per cent, although at first it was as high as 4.25 per cent, the percentage of failures of oil lamps under the same conditions being 1.25 per cent. He also gave a review of the various attempts to use primary battery lamps as miners' lamps. An account is also given of the extended discussion which followed.—Lond. *Elec.*, May 10.

REFERENCE.

Blue Printing by the Electric Light.—An illustrated description of a method of the Gen. Elec. Co. to use the light of enclosed-arc lamps for making blue prints.—*Eng. News*, May 23.

Power

Electric Installation in a French Mine.—Davies.—An abstract of a paper, read before the Inst. of Mining and Met., in which he gives a description of the electric installation which has been working the argentiferous lead and blende mines at Pierrefitte in the French Pyrenees since 1898. The total fall available was 26.13 meters, and the quantity of water 2200 litres per second. Two 420-hp turbines are installed, directly coupled to dynamos giving 400 amperes at 750 volts, when running at 425 r. p. m. This voltage was chosen to permit of interchange of current with the Pierrefitte-Canterets electric railway, which has a 3000-hp station 2 miles higher up the river. There are in all eight motors, one 100 horse-power for compressor, one 30-hp crusher motor, five 28-hp motors for jiggers and vanners, and one 10-hp motor for the machine shop.—Lond. *Elec.*, May 17.

REFERENCE.

Water Power in Switzerland.—Prasil.—A well illustrated article on the development of turbine building in Switzerland and the equipment and capacity of the great turbine-building works, and of the important water-power plants erected in Switzerland since 1889.—*Eng. Mag.*, May, June.

Traction.

Accumulator Traction on German Railways.—Gayer.—A paper on the experiments made with accumulator cars on sections of the Bavarian Palatine Railway system. These cars are run on sections where there is not enough local traffic to justify the operation of many way trains with steam locomotives, and yet where a frequent service is very desirable. They also act as feeders for through express trains by picking up passengers at way stations and carrying them to the express stopping places. The four cars which were in operation in 1900, covered 58,000 miles on main lines and carried 300,000 passengers, two of these are four-axle cars with a seating capacity of 112 and two are three-axle, carrying 68 passengers. On some of the trips a trailer is carried which adds 50 to the seating capacity. The cars are heated and lighted with current from the accumulators which are placed in wooden boxes under about two-thirds of the seats. These boxes are carefully lined with isolacite and linoleum, have an outlet at the bottom for any acid which may get spilled, and are ventilated to allow the escape of fumes. There are six cells in each box, each cell containing 7 positive and 8 negative plates, 30 square centimeter. The connections are screwed. Each car carries 156 cells, with a guaranteed capacity of 225 ampere-hours, and as only about 120 ampere-hours, on the average are consumed on the longest run, there is a reserve of about 90 per cent. This large reserve was provided in order to avoid discharging the batteries too far, and also to allow for any depreciation. The batteries are charged at the end of every trip for a time varying from 30 to 75 minutes, with a current of 150 to 200 amperes. For each car there are two four-pole motors, which drive both axles of the truck through gearing with a ratio of 1 to 3. The cars run at an average speed of about 24 miles per hour, and cover about 90 miles a day. The empty cars weigh about 57,000 lbs., the batteries about 33,000 lbs., and the motors

8800 lbs., a total of about 99,000. When carrying 106 passengers, a motorman and a conductor, the total weight is about 117,000 lbs., or about 14,600 lbs. load per wheel. The cost of such a car with its electric equipment is given at about $13,750. Allowing for depreciation of the battery and assuming its electrical efficiency to be 65 per cent, and the price of 1 kilowatt-hour to be 24 cents, it is found that the total operating expense, taking interest, depreciation and everything else into consideration, is 10.5 cents per car mile, or 0.1 cent per seat-mile. These figures are lower than those for steam traction under similar conditions.—*Glaser's Annalen;* abstracted in *Eng. Mag.*, June.

Kingsland Surface Contact System.—An illustrated description of the surface contact system devised by Kingsland and exhibited in operation on an experimental track at Wolverhampton. The principal feature of the system is the use of a revolving tappet wheel to work the switches, operated by "striker bars" attached to the cars. The wheel is placed in a slot between the tram rail and an additional rail, into which the striker bar projects, and the switch is enclosed in a water-tight box beneath the pavement. The contact studs are, as usual, placed midway between the rails, and the return circuit is made by the rails themselves. It is claimed that the operation of the switches by a positive mechanical action does away with the difficulties and uncertainty with which the surface contact principle has generally been associated. The details of the system are described and illustrated.—Lond. *Elec. Rev.*, May 10. Further descriptions of this system in Lond. *Elec., Elec. Rev.*, May 17. The latter journal makes some criticism, but considers the system eminently practical, and the only surface contact system on which it would pin its faith for permanency.

Economy of Electric Traction in France.—A discussion of the experiences of six French tramway systems which have recently changed over from animal to electric traction, the results being analyzed in a number of tables. The most characteristic feature of the substitution of electric traction for animal is the increase in the number of passengers carried, which varied between 209 and 37 per cent. The frequency of traffic is one of the most telling causes for the popularity of the electric roads. The following opinion of de Marchena is quoted. When a line is overloaded with passengers, the receipts increase in proportion to the number of cars in service, but after reaching a certain point, which might be called the "saturation point," the increase in receipts grow less than the increased frequency of service. Nevertheless, when the operating expenses are small, it is profitable for the road to pass this point and increase the service as long as the extra receipts exceed the extra expenses. "With electric traction in particular, a railway is not being worked to the best advantage until the activity of circulation is such that each car carries only a few passengers." The increase in gross receipts varied from 158 to 49 per cent. The receipts per car mile show a decrease, varying between 24 and 0 per cent. The decrease in operating expense per car mile carried, between 53 and 15 per cent. But owing to the much greater number of car-miles with electric traction, the total operating expenses increased. This increase varied between 90 and 36 per cent, but was in every case less than the increase in gross receipts, so that there was a gain in the net receipts, varying between 1035 and 136 per cent. Notwithstanding the much larger investments due to the electric equipment, there is an increase in the rate of dividends in every case with two exceptions, where it was governed by local circumstances.—*Le Genie Civil;* abstracted at some length in *Eng. Mag.*, June.

Massachusetts.—A long illustrated article on the street railway system of the Massachusetts Electric Companies.—*St. R'y Rev.*, May 15.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Great Grimsby.—An illustrated description of this British municipal electric plant. The generating sets comprise three 150-hp steam dynamos, running at 550 r. p. m., and two 75-hp steam balancers running at 550 revolutions. The larger dynamos are designed to have an output of 192 amperes at 480 volts when running at normal speed, but they are also capable of running steadily at any e. m. f. from 460 to 520 volts as shunt machines from no-load to full-load, with a variation of speed not exceeding 5 per cent from the normal, and they carry 20 per cent overload for a short time. These machines are also compound wound for working the system of tramways that is being introduced, the compound winding being so proportioned as to raise the voltage from 500 at no-load to 550 at full-load without adjustment of the shunt regulating resistance or alteration of the engine governor. There is also a battery of Tudor cells for the day-lighting load, capable of giving 60 amperes for five hours, or 120 amperes for 30 minutes. They are charged by two boosters driven by a single motor. The charging current is 60 amperes, and the boosters raise the station voltage 10 to 70 volts, as desired when running at 1000 r. p. m., or 90 volts with a 5 per cent increase of speed.—Lond. *Elec.*, May 17.

Hartford.—A long illustrated description of the Hartford Electric Light Company's system. There are two separate hydraulic stations at which 500-volt, two-phase current is generated, transformed to 10,000-volt, three-phase by the Scott system and transmitted to the central receiving station in the city. At this station is also placed the steam auxiliary. Operated in connection with it is a sub-station in which the current generated both by the steam plant and the water-power plants is transformed and converted for distribution, and where a balancing storage battery is installed, while smaller sub-stations in other portions of the city take care of the constant current (alternating) arc lighting system.—*Elec. Rev.*, May 18.

REFERENCE.

Heating from Central Stations.—ADAMS.—The first part of an article on the design of pipes for hot-water heating from central stations. —*Elec. Rev.*, May 18.

WIRES, WIRING AND CONDUITS.

Insulation Resistance of Gloves for Wiremen.—JANET.—A paper read before the Internat. Soc. of Elec. in Paris, in which he gives an account of laboratory experiments with low and high pressure. He measured the insulation resistance of six different types of insulating gloves for wiremen at a pressure of 105 volts, first in dry and then in wet condition. For the dry tests each glove was filled with mercury and suspended to a height of 8 inches in a basin of mercury. For the wet tests instead of the mercury fine sand was used, moistened with acidulated water. The insulation resistance in megohms was found to be for the six types, as follows: 0, 0; 0, 0; 540, 4; 4800, 420; 6200, 24; 52,500, 157; the first numbers referring to the dry tests and the second to the wet tests, respectively. He also made wet tests for determining the effective e. m. f., at which the gloves broke down under high-pressure alternating currents. Three types broke down at low voltage, while three other types broke down at 2500, 1000 and 11,000 volts efficiency, respectively. These six types of gloves had been tested on account of a competition, arranged by the Assoc. of Manufacturers of France for preventing accidents, in order to better the manufacture of insulating gloves for wiremen. In the discussion which followed Hillairet said these tests confirmed his opinion, that insulating gloves cannot generally be regarded as an effective protection, and that it would be better to forbid their use than to rely upon them in contact with dangerous conductors. Wiremen with gloves should not touch the conductors directly, but only such parts as are already insulated, like the non-metallic handles of interrupters.—*Bull. de la Soc. Int. des Elec.*, April.

ELECTRO-PHYSICS AND MAGNETISM.

Electrical Conductivity of Air and Salt Vapors.—WILSON.—An abstract of a Royal Society paper, in which he describes experiments undertaken to obtain information on the variation of the conductivity of air and of salt vapors with change of temperature, and on the maximum current which a definite amount of salt in the form of vapor can carry. Among other things he found that the maximum current carried by the salt vapor (at 1300 degs. with 800 volts) was found to be nearly equal to that required to electrolyze the same amount of salt in a solution. He regards this fact as considerable evidence in favor of the view that the ions are of the same nature in the two cases.—Lond. *Elec.*, May 17.

Influence of Pressure and Temperature on Dielectric Constants.—KOENIGSBERGER.—A development of equations differing essentially from those of Thomson, Drude, Duhem, and others, owing to the fact that he takes into account certain quantities of energy not considered by those authors and which, he thinks, makes a great difference in the case of high dielectric and magnetic constants. He shows that "in solid and liquid bodies the change of a parameter in the electric field has a different effect from that which it would have outside the electric field (or the magnetic field in magnetic substances), and that when such substances are electrified, the phenomenon of electrostriction, of Thomson's heating, etc., must be observed."—*Ann. der Physik*, No. 5; abstracted in Lond. *Elec.*, May 17.

Disruptive Discharge in Electrolytes.—BROCA and TURCHINI.—In experimenting with electric oscillations of a wave-length of some

400 meters, corresponding to a frequency of about 1,000,000 per second, they found that the properties of an electrolyte placed in the discharge circuit were profoundly modified. Under favorable conditions very powerful disruptive discharges passed through highly conducting liquids, thus showing that for this order of frequency the electrolytes behave as dielectrics. They believe that at sufficiently high frequencies all transparent electrolytes behave as dielectrics.—*Comptes Rendus,* April 15; abstracted in Lond. *Elec.,* May 17.

Oscillating Sparks.—HEMSALECH.—An ordinary spark has a very irregular shape, owing to the irregular distribution of the metallic vapor given off by the electrodes. Besides, the luminous track produced by the initial discharge is strongly marked. He has, however, found that if a variable inductance is inserted in the circuit, then on increasing the inductance the shape of the spark becomes more and more regular, and the initial discharge recedes more and more into the background so that eventually the discharge appears to consist entirely of incandescent vapor. The shape then taken by the spark is that of a sphere or ellipsoid, with its major axis along the discharge path.—*Comptes Rendus,* April 15; abstracted in Lond. *Elec.,* May 17.

Vacuum Tube Discharge.—KORN.—If two electrodes, mounted in a vacuum tube about 2 cm. apart, are both connected with the negative pole of an influence machine or an induction coil, and a discharge is produced, a bright surface appears between the electrodes, and when one of them is lengthened, the surface approaches the corresponding electrode. This phenomenon was first described in Jaumann and used by him to support his theory of longitudinal light. His experiments have been repeated by the present author, who has added an interesting new fact. The bright blue trace of the "*J*-surface" on the wall of the tube is not always straight. It is, in fact, generally wave-shaped and the displacements of the surface are marked by a simultaneous progression or retrogression of the wave-line.—*Ann. der Physik,* No. 5; abstracted in Lond. *Elec.,* May 17.

Becquerel Rays.—RUTHERFORD.—An account of an investigation of the effect of heating radio-active thorium compounds. Red heat increases the radio-activity to about three times its original value. White heat destroys it almost completely, and cooling the specimen leads to no recovery. If the temperature never exceeded a red heat, the preparation returns to its normal activity on cooling, but a bright red heat considerably retards the process. The behavior of radium preparations is very much more remarkable. A bright red heat increases the radio-activity 5000 times. Further heating seems to interfere with or partly destroys the radio-activity at the lower temperatures. He inclines to the conclusion that the radio-activity is due to some chemical process within the material. Dorn's observation that the radio-activity is increased by moisture confirms this supposition.—*Phys. Zeit.,* April 20; abstracted in Lond. *Elec.,* May 10.

REFERENCE.

Wimshurst Machine.—A French Academy note on the theory of the Wimshurst machine without sectors.—*L'Elec.,* May 11.

ELECTRO-CHEMISTRY AND BATTERIES.

Porosity in Storage Battery Plates.—FAY.—A comparison of the Plante and Faure types of accumulator plates. For the Faure type it has generally been supposed that the active material is so porous that a thickness of 0.4 inch of the salts in compressed pastilles would not be excessive, but this supposition is only correct, provided reference is made to batteries in which the rate of discharge is based on 10 hours for the complete discharge, and, furthermore, provided the active material is not dense as it would be if applied under great pressure. Plates made of pastilles often harden in service, especially in vehicle work, so that the porosity is diminished. The watt output per pound in batteries of this class is about as follows: Ninety per cent of rating up to the 20th discharge, 100 per cent of rating from the 20th to the 50th discharge; 83 per cent from the 50th dicharge, the changes being gradual. This result is based on the observations of the performance of over 300 batteries in actual service, the negative pastilles being about three-eighths of an inch thick. The porosity factor does not affect the electro-chemically formed plate, as it does the pastille type. He gives a comparison of both types, the weight of complete cell is 33 lbs. for the electro-chemically formed type and 34.75 lbs. for the pastille type, respectively. The weight of element only 25.5 lbs. and 27.5 lbs.; the weight of electrolyte 6 and 5.75 lbs.; the output rate in amperes 30 and 30; the duration of discharge 5 and 4 hours; the ampere-hour output 150 and 120 ampere-hours. The electro-chemical type, weighing about 95 per cent of the weight of the other type, gives 100 per cent output as against 80 per cent output for the other type, taking the electro-chemical type in comparison at a time when the other type is at its best. He says that batteries in which the output depends to any great extent on porosity, like the pastille type, will not survive, in vehicle work at any rate. He recommends for electro-chemically formed plates to have plates weighing about 7 lbs. per square foot, so grooved and then formed as to give the output below under these conditions. Weight of lead per cell 78 per cent, electrolyte 17 per cent, jar and separator 5 per cent; output at the rate of 5 amperes per pound, at a 5-hour rate of discharge, when formed to the maximum, reference being had to vehicle batteries in which the plates are about 50 per cent higher than they are wide. On this basis the life of the electro-chemical type of battery will be commercial and a delivery wagon equipped with such a battery will cover 240 miles per week, on 6 charges of the battery.—*Elec. Rev.,* May 18.

Copper Process.—ZWALUWENBERG.—A brief article on the extraction plant of the Arlington Copper Company at Arlington, N. J. The ore consists of sandstone and shale impregnated with a number of compounds of copper, principally the green carbonate, with small proportions of chalcocite, a silicate, and an occasional color of cuprite. The ore is to be treated by a method which varies little in principle from the Siemens & Halske process for the treatment of similar ores, but differing considerably in the manner of manipulating the material. The copper will be extracted from the ore by a leaching operation, the solvent consisting originally of dilute sulphuric acid, but after being used for some time containing considerable ferric sulphate. Before it is subjected to the action of the solvent, the ore will be dried, crushed and roasted. The solution containing the dissolved copper will be subjected to electrolysis, the copper being obtained in metallic form and ferric sulphate regenerated at the anode, thus rendering the liquor available for the extraction of copper from a fresh portion of ore. It is expected that the solution can be used for some time before becoming seriously fouled by soluble substances present in the ore.—*Eng. and Min. Jour.,* May 25.

Behavior of the Aluminum Anode.—BARTORELLI.—An account of measurements with the voltameter. He uses a sulphuric acid solution of 5 per cent in volume, and a platinum cathode and an aluminum anode. For a current density between 0.004 and 0.1 ampere per square centimeter, he found that the ohmic resistance of the voltameter decreases with increasing current density, that it is independent of the distance of the electrodes and inversely proportional to their cross-section. Further, that the polarization e. m. f. depends only upon the current density and increases with increasing current density, the increase which is small in the beginning, gradually becomes smaller and tends to a certain limit.—*Phys. Zeit.,* May 11.

REFERENCES.

Determination of Copper.—SMITH.—A detailed description of an electrolytic method of determination of copper, which he thinks to be by far the best, where not more than 10 assays are required daily.—*Eng. and Min. Jour.,* May 25.

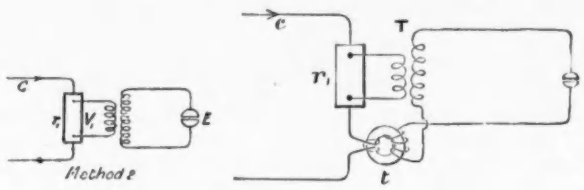
Benzidine.—LOEB.—An account of a continuation of his researches on the electrolytic production of benzidine.—*Zeit. f. Elektrochemie,* May 9.

Lowering of Freezing Points.—MACGREGOR.—The first part of a paper on a diagram of the lowering of freezing points of electrolytes.—*Elektrochem. Zeit.,* May.

UNITS, MEASUREMENTS AND INSTRUMENTS.

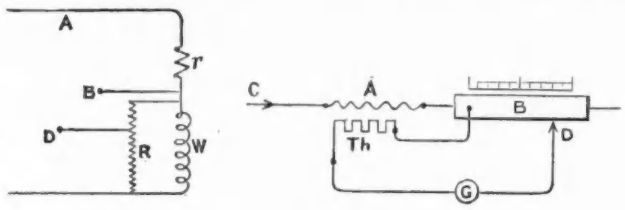
Alternating-Current Measurements.—CAMPBELL.—An illustrated Brit. Inst. Elec. Eng. paper on test-room methods of alternating-current measurements. He first deals with transformer methods of measuring current, voltage and power. One well-known method is to send the whole current to be measured through the primary coil of a transformer, the secondary of which is connected to an ammeter. For this method it is necessary to have an air-core transformer, or one with a well-closed iron circuit, also relatively low resistance and high inductance in the secondary circuit. Another method, shown in Fig. 1, is to pass the current through a low non-inductive resistance r_1, giving a small voltage drop, which is transformed up so as to give readings on the electrostatic voltmeter *E*. Here the measuring instrument, being electrostatic, is unaffected by variations in frequency, and, if of good type, has a very high degree of accuracy. For currents from 5 amperes and upwards, the resistance r_1 should be so small that not more than 0.5, or at most, 1 volt, is lost in it. If the voltmeter reads to about 120 volts, this necessitates a high trans-

formation ratio, at least 1:100, in the transformer. To keep the voltmeter readings proportional to the current, he finds it best to use a transformer with a well-closed iron circuit and a highly inductive primary coil of very low resistance. While for the latter reason a considerable weight of either iron or copper would be required, he shows in a numerical example that very fair accuracy may be attained with quite a small transformer. It is possible, however, to compensate for changes of frequency by the modification shown in Fig. 2. Here the total current c, after passing through the small resistance r_1, passes through a turn or two on a very small compensating transformer t, whose secondary is connected (reversed) in series with the secondary of the main transformer T and the voltmeter. As the frequency is raised, the transformer t subtracts more and more from the voltmeter reading, and thus compensation can be secured. He then describes several methods of measuring power, among them the following modification of the usual three-voltmeter method, which gets over the difficulty that in order to get good readings the auxiliary resistance would use up a considerable fraction of the total available voltage, and would tend to alter the wave-forms in the cir-



FIGS. 1 AND 2.

cuit. In Fig. 3, r is a relatively small resistance and R a very high resistance in parallel with the load W. A convenient fraction, say, the nth part, is picked off R by the part $B\ D$, and the three-voltmeter method is applied to $A\ B\ D$. The result, multiplied by n, gives the power taken by W. He then refers briefly to the measurement of power-phase differences close to 180 degs., and discusses at some length the testing of watt-hourmeters with real non-inductive loads, inductive loads, and fictitious loads. He mentions thermopile methods and describes the interesting zero method of measuring direct current, shown in Fig. 4. The current passes, wholly or in part,



FIGS. 3 AND 4.

through the thin wire A and also through B, a strip or rod of very low resistance. The heating of A by the current causes the thermopile Th to give an e. m. f. e which is balanced against a part of the voltage drop along B by moving the slider D until the deflection of the detector galvanometer G is brought to zero. The graduations of the scale of the slider are directly proportional to the current measured. He then describes a method of obtaining steady currents with varying supply voltage. He accomplishes this by means of a Wheatstone bridge arrangement with two different metals for the wires, of large and small temperature coefficients, respectively. The method is described and its function is explained by diagrams. The paper is concluded by some remarks on zero methods of measuring current.—Lond. *Elec. Rev.*, May 10, 17.

Alternating-Current Measurement.—ADDENBROOKE.—A communication in favor of his electrostatic instruments. He compares briefly the dynamometer with the electrometer as a watt-meter. He says that he has worked out carefully a complete scheme for calibrating and operating a set of instruments on the dynamometer principles, on as similar lines to his own as he could, and that he came to the conclusion that to ensure equal accuracy and equal facilities, the dynamometer set would be much the more cumbrous and costly, besides which several advantages are wanting which are readily obtainable with an electrostatic method.—Lond. *Elec.*, May 10.

REFERENCES.

Industrial Magnetic Measurements.—MONTPELLIER and ALIAMET.—A continuation of their illustrated serial. They describe the torsion permeameter of Carpentier and the magnetic bridge of Holden.—*L'Elec.*, April 20.

Registering Instruments.—PERRIN.—A long illustrated paper read before the Internat. Soc. of Elec., in Paris, in which he gives a description of a large number of instruments for registering current, e. m. f. and power curves.—*Bull de la Soc. Internat. des Elec.*, April.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Acoustic and Electric Constants of the Telephone.—WIEN.—An interesting investigation of the question how much the telephone, as an electromagnetic apparatus on the one hand and as an acoustic apparatus on the other, is sensitive for various frequencies to the same degree. This question is fundamental for a distortionless transmission of speech. He determined the acoustic and electric constants of the following four telephones: A Bell telephone, an older telephone by Siemens & Halske, a newer telephone by Siemens & Halske, and a box telephone by Apel, of Goettingen. The distinctness of speech was about the same in all the four telephones. To show how the current depends on the frequency for constant e. m. f. he gives in a table the effective resistance and inductance of the four telephones for frequencies varying between 0 (constant current) and 16,000. The effective resistance, in accordance with the greater loss of energy through eddy currents, rapidly rises with increasing frequencies, and even attains the 13-fold value of the original resistance in the newer Siemens telephone. The Bell telephone has by far the smallest resistance of the four. The effective resistance, on the other hand, decreases, most of all in the old Siemens telephone, when it falls to about one-fifth of its value for 256 periods. The latter change is of great influence at the higher frequencies, as it causes an increase of the current at constant e. m. f., and an increase of the loudness of the higher notes. On the other side, the magnetic induction falls with increasing frequency and reduces the amplitude of the diaphragm and the intensity of the higher notes. There are, therefore, two opposing influences. Whether they just compensate each other at a certain point or whether the higher notes are strengthened or enfeebled, depends upon external conditions, such as the resistance and capacity of the line, etc. Of wider influence are the purely acoustic properties of the telephone. He gives a table of the sensitiveness of the four telephones, determined by him by measuring the current strength in hundred-millionths of an ampere, that produced a current which he could just perceive with certainty at break and make with his right ear, for 13 frequencies varying between 64 and 16,000 periods per second. The Bell telephone has all along a smaller sensitiveness than the other three instruments, in accordance with its smaller resistance. All the four telephones show a specially high sensitiveness for the currents between the pitches 500 and 3000. Both downward and upward the sensitiveness decreases rapidly, so that, for instance, in a Bell telephone for N equals 64, a nearly 10,000-fold current intensity, or a more than 100,000,000-fold current energy is required to produce an audible note than for N equals 1024. This steep fall in the sensitiveness for high and low pitches cannot be explained solely by the acoustic properties of the telephone or the proper notes of the diaphragm, but is most largely due to the variations in the sensitiveness of the human ear. The most important and characteristic notes of the human voice fall between the pitches 500 and 3000, where all the four telephones show the greatest sensitiveness. This circumstance probably conduces greatly to the distinctness of transmission. On the other hand, the differences in sensitiveness for comparatively small differences of pitch are very great just within this range, since the most important proper notes of the diaphragm fall within it. The human ear has, however, an astonishing sensibility for the characteristic marks of the vowels and consonants, which are not even obliterated by the great changes in the timbre bound to take place in consequence of the acoustic and electromagnetic properties of the telephone.—*Ann. der Physik*, IV., 3; translated in Lond. *Elec.*, May 10.

REFERENCES.

Wireless Telegraphy.—An illustrated description of the Popoff-Ducretet apparatus for wireless telegraphy.—*Sc. Amer.*, May 25.

Telephone Switchboard.—An illustrated description of the telephone switchboard used by the German Mail Department, which is also in charge of telephony in that country.—*Elek. Zeit.*, May 2.

MISCELLANEOUS.

Response in Living and Non-Living Matter.—An editorial on Dr. Bose's theory of response in livng and non-living matter, propounded

by him in a recent Royal Institution paper. His researches lead to the discovery of an universal action underlying certain phenomena in both living and inorganic matter. He discussed the responses of living muscles and nerves to different kinds of stimuli and their representation by diagrams. He then discussed the response of inorganic or non-living matter. When a piece of wire is placed in a galvanic circuit and one end of the wire is momentarily subjected to mechanical stimulus, as by twisting or tapping it, an electrical response takes place in the form of a current between the injured or stimulated end and the normal end of the wire. He experiments with an apparatus for measuring and recording such responses and found that the response and recovery curves obtainable from it correspond in the closest possible degree with the physiological curves obtained from living nerve and muscle.—Lond. *Elec.*, May 17.

REFERENCE.

Paris Exposition.—The 18th part of the illustrated serial, dealing with the telephone exhibit of the British Post Office, the Siemens & Halske 14,000-subscriber flat board, the Commelin & Viau gas accumulator and an electrically-driven dogcart of English make.—Lond. *Elec.*, May 17.

New Books.

JAHRBUCH FUR ELEKTROCHEMIE. V. und VI. Jahrgang, 1898-99. Von Dr. W. Nernst und Dr. W. Borchers. Halle: Wilhelm Knapp. Volume for 1898, 496 pages and 195 illustrations. Price, 20 marks. Volume for 1899, 431 pages and 204 illustrations. Price, 16 marks.

One of the serious disadvantages resulting from the increasing amount of technical literature published at the present time, is that the busy man, who is generally the very one who wishes to keep posted on new or important developments, cannot read it all and often, cannot even take time to pick out from the large amount published, that part (usually a small fraction), which is of permanent value. It is therefore of great value to any profession if some one capable of doing so, collects and publishes annually all that which is worth keeping for reference. This is what is being done for the science and industry of electro-chemistry, in this excellent annual publication, of which the above are the two latest volumes published. It may safely be said of this work what can be said of comparatively few, that it should be in the hands of every one interested in this subject. To the busy man it will save its cost many times over.

Of the two authors, Nernst is so well known to electro-chemists for his scientific work that his name is a sufficient guarantee that the scientific side is in able hands. The other author, Borchers, has also achieved some international fame as editor of one of the best journals on electro-chemistry, although we regret to say that he is often too apt to introduce his personal views in a very decided way; in the comparatively young science and industry of electro-chemistry it does not always follow that if there is a difference of opinion, one of the parties must necessarily be entirely wrong. The present work, however, is a well digested and arranged compilation, and is therefore largely free from personal views of the editors, although opinions are often expressed, which, coming from authorities, are generally reliable and conservative and add to the value of the book.

Besides these two authors there are associated with them in the preparation of this book, Prof. Dr. Elbs, who has charge of all that which refers to the generation of current, accumulators, and organic compounds; Prof. Kuester, in charge of electric analyses, and Prof. Danneel, who cares for the purely scientific subjects. Prof. Borchers prepared the portion on electro-metallurgy and apparatus. Nothing appears over the name of Nernst, who may therefore be more of a general consultant.

The subjects are well arranged and classified, so that if one wants to know what has appeared on a certain subject, it will all be found together under that title. The matter consists mostly of a digest of all that appeared on each subject, including tables of data, and illustrations when necessary, and is always accompanied by references to the original journals. In some cases references are also given to articles which, being of less importance, are not abstracted. At the conclusion of each section there is a list of patents with their reference numbers, issued in the principal countries during the year. Each volume concludes with a two-page list of the best books on this and allied subjects published during the current year; also, a list of technical and scientific journals, which, however, is quite incomplete. This is followed by a very long index by authors and another by subjects. There is also a good table of contents at the beginning of the book.

The preparation of this annual involves considerable work, as it is not a mere collection of individual abstracts, but rather a connected account, and it is hoped that the quality of the work in succeeding years will continue to be as good, notwithstanding the fact that both Nernst and Borchers have recently severed their connection with the *Zeitschrift fuer Elektrochemie,* of which they were joint editors for a number of years, and in which capacity they had an excellent opportunity of remaining posted on what was being published.

INSTRUMENTS ET MÉTHODES DE MESURES ÉLECTRIQUES INDUSTRIELLES. H. Armagnat. Paris: Georges Carré et C. Naud. 586 pages, many illustrations. Price, 12 francs.

The greater part of this book is a collection of a series of articles by the author, which appeared some time ago in one of the leading French electrical journals and were noticed and abstracted at the time in the Digest of this journal, the readers of which are therefore already familiar with the substance of the book. The author, as the head of the measuring department of one of the leading electrical and physical instrument makers of the world (Carpentier of Paris), has naturally had extended and valuable experience with electrical instruments, their theory, and their design, and he may therefore safely be considered an authority on this subject.

The book is divided into two parts, the first on instruments and the second on measurements. The first chapter deals with the general theory of instruments giving deflections, and includes discussions of the theories of suspensions, deflections, oscillations, etc., and the best arrangement of suspension systems, etc, as found from practice. This is followed by such general subjects as the scales, mirrors, beams of light, etc., and the laws governing them. The succeeding chapters are devoted each to one class of instrument, with the theory of its action, formulas used therewith, illustrations of forms of the instruments, etc.

In the second part, which constitutes about one-third of the book, the theories of the various methods of measurements are given, beginning with a discussion of the question of errors, a chapter being devoted to each class of measurements—not only the more usual, but also those not generally included in books on measurements, such as those relating to co-efficients of induction, magnetic fields, magnetic properties of iron, etc.

In general, the treatment of the subject is of a high class, involving a thorough knowledge of the theories of measurements and instruments, and the book will be found to be very useful to those who work with or are interested in electrical instruments, chiefly of the higher class for laboratory and research work. Commercial measurements, and those in shops, as in the testing of electrical machines and transformers, are not included, as the subject is treated in a general way, leaving it to the one who uses the methods to select the one best adapted.

As the author is associated with an instrument maker, the instruments described are naturally those of this maker. In fact, much of the book deals with this particular maker's styles and types of instruments, which is not to its discredit, as they have a world-wide reputation, but this limits the scope of the work more than is desirable, as other makers also make good instruments. The Weston instruments, for instance, which are so well known, are, it seems, not even mentioned in the whole book. While the maker with whom the author is associated, may not, and to the knowledge of the reviewer does not, approve of the Weston type of instrument, this is no reason why they should not be mentioned, though perhaps they are excluded as being a commercial instrument which can be used without a knowledge of its theory or properties.

Some bias is also shown in other subjects. For instance, while numerous pages are devoted to the Clark standard cell, and several to the Daniell, the Weston cadmium cell, which is recognized by such a high authority as the Reichsanstalt to be the superior, is referred to only in a few lines, which state that it has a very small temperature co-efficient, adding that the tests made with it have not been sufficiently numerous (as though the number of tests was of more importance than their quality) to give an exact idea of its properties. The author was evidently not familiar with the work of the Reichsanstalt with this standard cell. The Daniell standard cell, on the other hand, which the reviewer believes to be nearly

obsolete, is said to be one of the most constant, and most used. While thus the book may be highly recommended and contains much that is useful, it is not quite as broad and impartial as might be desired.

BOOKS RECEIVED.

ELEKTRISCHE VERBRAUCHSMESSER DER NEUZEIT. Von Johannes Zacharias. Halle: Verlag von Wilhelm Knapp. 351 pages, 195 illustrations. Price, 15 marks.

CENTRAL ELECTRICAL STATIONS. Their Design, Organization and Management. By Charles Henry Wordingham, A. K. C. London: Charles Griffin & Co., Limited. Philadelphia: J. B. Lippincott Company. 496 pages, 136 illustrations. Price, $7.50.

ATOMS AND ENERGIES. By D. A. Murray. New York: A. S. Barnes & Co. 202 pages, with diagrams. Price, $1.25.

CENTRAL STATION EXPERIENCES. A Series of Narratives on the Trials and Tribulations of a Steam Engineer while Learning to Run an Electric Station. From *Power*. New York: The Power Publishing Company. 106 pages, illustrated. Price, 75 cents.

Directory of Electrical Societies, Etc.

AMERICAN STREET RAILWAY ASSOCIATION. Next meeting, New York, Oct. 9, 10 and 11, 1901.

ASSOCIATION OF THE EDISON ILLUMINATING COMPANIES. Next meeting, Sept. 10, 1901.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Next meeting, Buffalo, N. Y., June 19, 20 and 21, 1901.

CANADIAN ELECTRICAL ASSOCIATION. Next meeting, Ottawa, Ont., June 19, 20 and 21, 1901.

INDEPENDENT TELEPHONE ASSOCIATION OF THE UNITED STATES. Next meeting, Buffalo, N. Y., June 11, 12 and 13, 1901.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Next meeting, Niagara Falls, N. Y., September, 1901.

NEW YORK STATE STREET RAILWAY ASSOCIATION. Next meeting, Rochester, N. Y., September, 1901.

NORTHWESTERN ELECTRICAL ASSOCIATION. Next meeting, Sheboygan, Wis., last week in June, 1901.

OHIO ELECTRIC LIGHT ASSOCIATION. Next meeting, Put-in-Bay, Ohio, Aug. 20, 21 and 22.

OLD TIME TELEGRAPHERS' ASSOCIATION AND UNITED STATES MILITARY TELEGRAPH CORPS. Next meeting, Montreal, Que., Sept. 11, 12 and 13, 1901.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Next meeting, York, Pa., Sept. 4, 1901.

The General Electric Pan-American Exhibit.

THE first large exhibit to be completed in Electricity Building at the Pan-American Exposition was that of the General Electric Company. In view of the delay in getting most of the exhibits in this building ready, this enterprise on the part of the company's representatives who planned and installed the exhibit was most commendable. The more so as the exhibit is such a large and comprehensive one, including types of all of the company's modern apparatus and supplies. The company occupies the entire northwest corner of the building. The Exposition service sub-station for decorative lighting consisting of 19 air-cooled transformers, of 250-kw capacity each, with the necessary switching apparatus, was rented to the Exposition Company by the General Electric Company, and forms part of its exhibit. This bank of transformers takes Niagara power at 11,000 volts, and transforms down to 18,000 volts for supplying the decorative illumination of the buildings, which is the great electrical feature of the Pan-American. The main 11,000-volt circuit to this sub-station is opened by one of the new electrically operated three-pole oil-break switches of the type which will be first commercially used on a large scale in the power house and sub-stations of the Manhattan Elevated Railway in New York, and which has already been described in these columns. It is operated by an electric motor from a small switch on the main panel of the switchboard. The first movement of the electric motor releases springs which throw the switch open to make a quick break, and the motor then continues running until it has put the springs under tension to make the return stroke. When the springs have been compressed the motor circuit is auto-

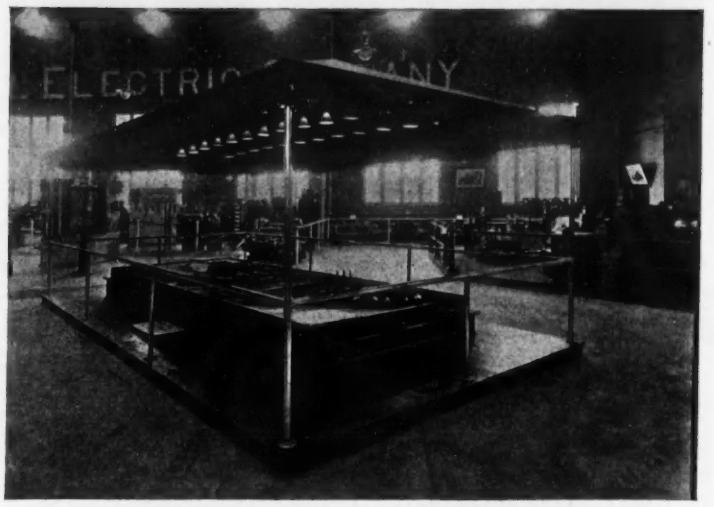


FIG. 1.—MODEL OF THE GENERAL ELECTRIC COMPANY'S WORKS.

matically opened at a contact on the switch operating mechanism. The motor always runs the same way for both opening and closing, and the reciprocating motion necessary to open and close the switch is furnished by a crank which the motor operates through the medium of a worm gear. The motor circuit operating the switch is controlled either by hand from the main panel of the switchboard or by a magnetic overload-circuit breaker on the main panel, which closes the motor switch in case of a short circuit on the line. The coils of this circuit breaker are connected with a small series transformer in the main circuit. The main 11,000-volt circuit, after leaving the main switch, supplies six banks of transformers, and in the circuit to each bank is a hand-operated three-pole oil switch.

The main panel has, in addition to the motor switch operating the main switch and the circuit-breaker switch, a polyphase Thomson

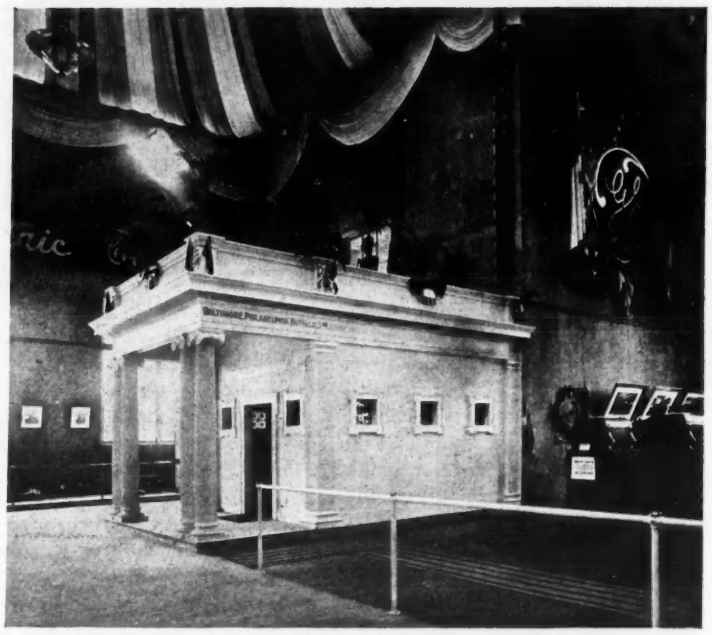


FIG. 2.—HEADQUARTERS.

recording wattmeter. The 1800-volt secondaries of the 18 transformers are all connected onto a common set of bus-bars from which 12 three-phase feeder circuits are taken for the distribution around the buildings. Each feeder circuit has a three-pole oil switch, hand operated, and an indicating wattmeter.

Probably the first thing to attract attention in the General Electric exhibit is the big field ring, which is one of five being built for the Niagara Falls Power Company's new plant. It is for a 5000-hp generator of a construction similar to that of the machines in the present plant. It is of nickel steel of a tensile strength of 40,000 lbs. per square inch within the elastic limit, weighs 17 tons and is 12 ft. in diameter outside. It will be remembered that this field ring is the revolving part on the Niagara machines, hence the necessity for great tensile strength.

After the field ring, the next most prominent piece in the exhibit is a 200-kw, three-phase alternator, of the new compensated revolving field type, having the exciter geared to the main armature shaft. By gearing the exciter, it can be maintained at a definite phase relation with reference to the armature. By putting three collector rings on the exciter armature and connecting them to the secondary of a transformer in series in the main circuit, the voltage of the exciter is increased with the load without the introduction of any rectifying devices. It is also pointed out that the drop in voltage with inductive load is better compensated for by this method than by any automatic method heretofore introduced. The 200-kw generator in the exhibit is designed for direct connection to engine or water-wheel and runs 200 r. p. m.

The operative part of the company's exhibit (outside of the Exposition sub-station which is separated by a railing from the General Electric Company's regular exhibit), begins with a bank of three 50-kw oil-cooled transformers operating on Niagara power at 25 cycles, and reducing from 1800 to 360 volts. A 200-hp synchronous motor is run every evening belted to a 100-kw compensated revolving field type alternator running 1900 r. p. m., which furnishes 2300-volt alternating 60-cycle current to two 75-light constant current series transformers, which light the Electricity Building. It also supplies a 5-light model of a constant-current transformer, made with a glass case so that the operation of regulation can be watched. This is supplying five enclosed-alternating arcs and one series incandescent. A very commendable feature of the arc lamp exhibit is that of putting very dark inner globes around the arc so that the action of the arc can be observed, and surrounding the feeding mechanism with glass instead of metal so that the feeding mechanism can also be observed. These lamps belong to what the company calls the interchangeable type. All use the same globes and casings, and differ from each other only in the mechanism necessary for the different circuits.

The mining department is well represented by a 10-ton mining locomotive which is one of a number built for the Union Pacific Coal Company. It is 30-inch gauge, and has 3500 lbs. draw-bar pull at 8 inches per hour. The brake shoes can be removed through doors in the top and the journal boxes can be taken out of the sides. Next to the mining locomotive is an electric mining hoist built by the Lidgerwood Manufacturing Company, 96 Liberty Street, New York, to which a G. E. 52-railway motor is geared. A further mining exhibit is a 50-hp three-phase induction motor geared by single reduction to a three-cylinder pump running 150 r. p. m.

The marine exhibit has one of the General Electric Company's neat 15-kw marine units consisting of a high-speed engine direct connected to a generator running 400 r. p. m. There is also a demonstrative exhibit of the use of tell-tale lamps in connection with bow and side lamps. When one of the bow or side lamps breaks, a relay in the pilot house lights up some danger lights before the pilot. Then by the pilot throwing a switch, a reserve lamp can be thrown in, at whatever lantern it is needed.

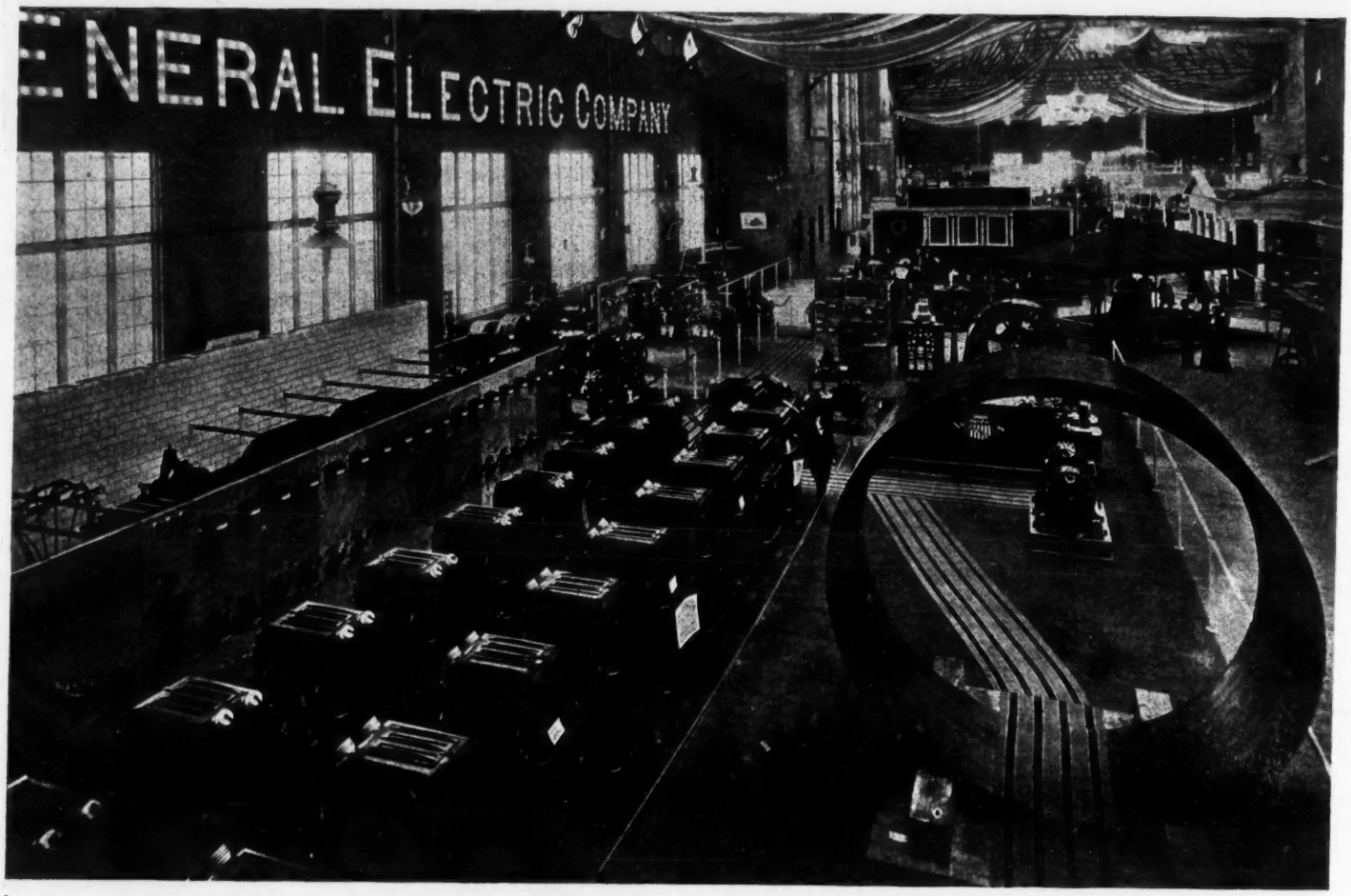


FIG. 3.—GENERAL VIEW OF THE EXHIBIT.

The railway exhibit has several features publicly shown here for the first time, most prominent among which is the new multiple unit system with two 125-hp motors in stationary operation and all auxiliary apparatus, as it is to be applied on the Manhattan Elevated railway at New York.

Two Brill 27 trucks are shown under a car floor frame on which are placed a couple of B 19 electric brake controllers. The trucks have four G. E. 67, 38-hp motors mounted on the four axles, and the truck is raised from the floor so as to show the operation of the electric brake with trolley on or off. A small two-cylinder air compressor for suburban and elevated motor cars is also in the railway exhibit. Railway motors of 25, 50 and 75 horse-power are shown on the floor so that the railway motors exhibited include the principal sizes from 25 to 125 horse-power.

A 7-hp motor generator reducing from 220 to 110 volts direct current for automobile charging, has been put in the space as representative of that class of work. On the switchboard are two types of oil switches and all the forms of quick break knife switches, and direct-current circuit breakers. Another side of the board is devoted to the

indicating and recording instruments made by the company. A third side has some circuit breakers for high-tension circuits in which the break is made inside a long tube, and the heated gases throw out the piston which makes the contact, and so break the arc. The motion of the two pistons which make the double break is downward. Numerous small applications of the electric motor, in which the general public will be interested are shown, for example, motors applied to a meat chopper, a spice grinder, a coffee grinder, an emory wheel stand, and fans and sewing machines. One of the landmarks of the exhibit is a Brush multi-circuit arc machine of 120-light capacity in four circuits. On a revolving frame in the middle of the space are all the incandescent lamp sockets made by the company, surmounted by a huge Edison socket. In another frame are all the porcelain supplies made, and in another the wires and cables. Visitors who attended the Paris Exposition are also greeted with the familiar sight of the illuminated model of the company's different works.

The foregoing is but a general review of this company's exhibit, many parts of which are highly worthy of a detailed study.

New Telephone Apparatus From St. Louis.

FIG. 1.

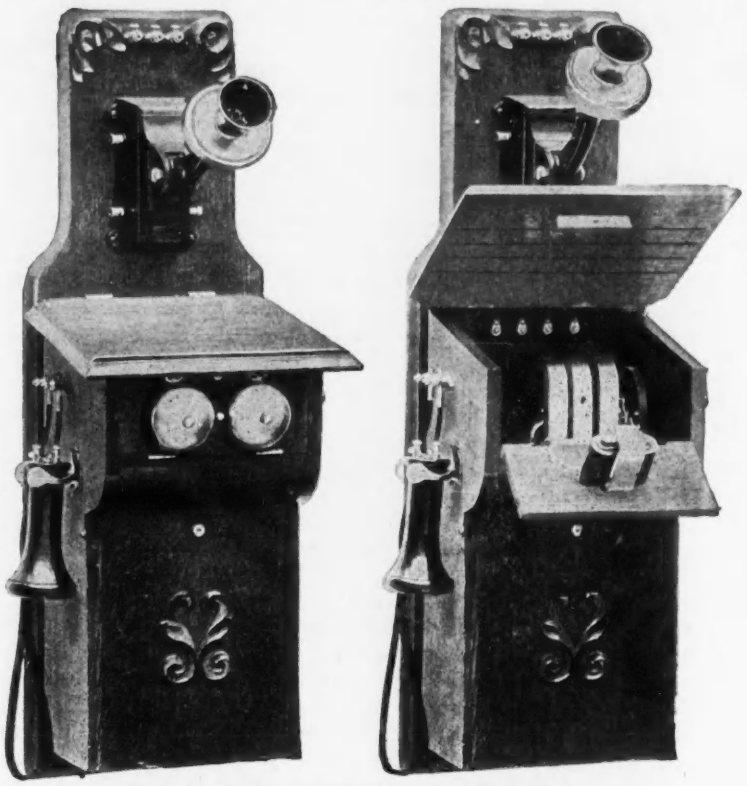
The Central Telephone & Electric Company, of 909 Market Street, St. Louis, has issued recently a batch of excellent trade literature relative to its new telephone apparatus for this season. It has now issued nearly a dozen catalogues on this class of output, so that its production is already well-known to the trade and to users.

A few of its latest specialties are herewith illustrated. Fig. 1 is its new No. 1 desk telephone, which is made in the Bell style, with sundry modifications and improvements. It includes its improved "Twentieth Century" transmitter, with the induction coil placed in the base, which, with the stand, is a heavy casting of brass finely nickel-plated. Platinum contacts are used on the gravity hook, the receiver cords and connecting cords are wrapped in silk, and the terminal block has the binding posts and connections marked plainly. The receiver is furnished with adjustable hard-rubber case, but the solid receiver can be had if desired.

Figs. 2 and 3 illustrated the Central Telephone & Electric Company's type called by it "Our Leader," being made on an exclusive design of very handsome appearance. In efficiency, utility and the general accessibility of all the parts, it has many recommendations. As will be noted, the receiver and the generator handle are on the same level, and at the height of the arm of the average man, while the transmitter is correspondingly on the level of the mouth. The transmitter connections are made with four binding posts in such a simple manner that the part can be removed in an instant. The other working parts are, as will be observed, under the writing desk lid, and equally accessible there on the application of a screw-driver to the two small screws that hold the lid down. Two Columbia dry batteries finish the equipment, and the set is furnished in either golden oak or walnut, which is supplied in series generator or bar bridging forms.

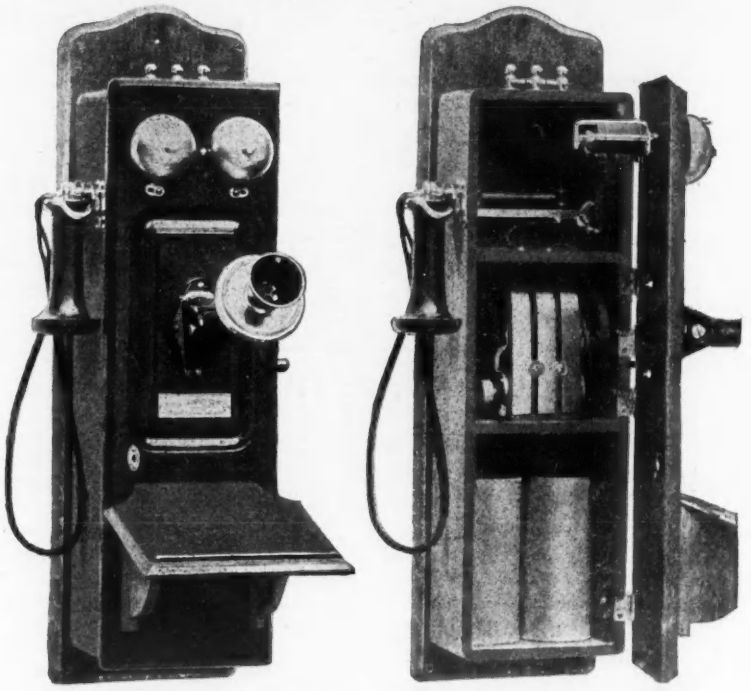
Figs. 4 and 5 illustrate the company's "Competition" dry battery type, with a different arrangement of parts, but of less costly woodwork and assembling, although the transmitter, receiver and generator are the same. It is built only in the golden oak finish, and is supplied with two Columbia dry batteries. It can be had with series or bar bridging generators, as desired.

The Central Company has also been pushing actively its switchboards, including the full metallic circuit for large exchanges, the small exchange boards, toll line boards, etc. In the 100 drop-board the drops are restored by direct action of the plug on the indicator without any additional mechanism. The drops fall backward, thus enabling the board to present a smooth, even surface, and preventing the operator from knocking down any indicator accidentally. The plug can be inserted slowly or quickly with the same positive restoring under all circumstances. Each drop coil is iron cased to avoid induction effects, and the drops are so constructed that the magnetic pull is secured at both ends. Both line drops are cut out of circuit



FIGS. 2 AND 3.—NEW TELEPHONE APPARATUS.

when the plugs are inserted and the self-restoring ring off drops are cut in. There is only one contact to be closed in the night-bell



FIGS. 4 AND 5.—NEW TELEPHONE APPARATUS.

circuit. The smaller boards and toll line equipments are equally ingenious and compact in construction.

Interior Telephone System for the Majestic Hotel, New York City.

The Lambert Schmidt Telephone Manufacturing Company feels especially gratified over securing the contract for installing the largest interior telephone equipment ever given out in New York City. The Majestic Hotel, ranking as one of the finest hotels in this country, has been heretofore using an indicating system, and finding it

inadequate for complete intercommunication service, has decided to make the change, and placed the contract with the Lambert Schmidt Company for a 500-line telephone equipment. The switchboard will be arranged with two operator's positions, and so that each operator can reach every jack on the board. This illustrates the compactness of the parts. The line drops will be of their automatic restoring type. The clearing-out signals are small incandescent lamps set in the table panel directly in front of the plugs. The switchboard will be supplied with the full complement of cross-connecting cords and plugs, listening cams and ringing keys, and night-bell circuit operated by relay. The operator's transmitters will be mounted on overhanging adjustable arms, and the receivers of the watch case pattern provided with triple adjustment head gears.

The current for the telephone system will be supplied from a storage battery located in the engine room of the hotel, this battery being provided with an appropriate power switchboard with ammeters and voltmeters for properly regulating the current. At the telephone stations will be located a small, compact instrument, consisting of transmitter, receiver, bell and switch hook. As the receiver is removed from the hook at the telephone the line drop at the switchboard rises and stays in that position until an answering plug is inserted in the correct jack, thereby cutting off the current from the drop, when it immediately restores to normal, covering the number. The operator throws down the listening cam, ascertains the connection desired, inserts the calling plug of the pair in the jack of that number, and throws down the ringing key, thereby signaling the station wanted. When the conversation is over, the hanging of the receiver on the hook at the telephone station raises the clearing-out drop directly in front of the pair of cords in use, and this drop stays in that position until these cords are withdrawn, when it automatically restores.

The notable feature of the switchboard is the sensitiveness of the drops. They are designed with the armature laid over the top of the coil, pivoted at the back of the drop and adjusted by a nut and coil spring. The shutter tips up as the armature is pulled toward the magnet. Its nice adjustment is demonstrated by the ability of the current of a single common dry cell to lift it up sharply. These shutters are made substantial, and will withstand severe handling. The line jacks are made of heavy phosphor bronze springs, with large break on the drop connections. The type of board used in this plant was illustrated in these columns April 13 last in connection with a description of the telephone plant of the Manhattan Hotel, New York, which plant was also installed by the Lambert Schmidt Company.

This interior telephone plant of the Majestic Hotel is an independent telephone exchange in every sense of the word. It illustrates a development in the telephone field that has not heretofore been thoroughly appreciated, and should serve as a model for the consideration of the many large hotels now being erected. The Lambert Schmidt Telephone Manufacturing Company has equipped many hotels, this being its finest plant in that line.

New Desk and Interior Telephone Apparatus.

The accompanying illustrations show some of the latest telephone apparatus for general interior work, and of "Bell type," made by the Haines & Noyes Company, of Chicago.

Fig. 1 is its new style of desk set. On this instrument it has done away with the use of outside contacts, and all contacts are in the base and of platinum. By this method, should the instrument fall, the contacts cannot become injured in any way, nor can they become dirty, covered with dust or corroded.

Another style made has a heavy cast base and copper upright, with cast throat. It is fitted with a standard transmitter, which has a heavy cast brass front and brass parts, and does not pack. This instrument is furnished with a Bell type bipolar pony receiver, with water-shrunk hard-rubber shell.

Fig. 2 is the latest Haines & Noyes telephone for hotels, apartment buildings, etc., for both local and interior use. This instrument is for its central energy system. It is furnished with a transmitter on a short movable arm, and with its standard receiver described above. It is provided with double-gong vibrating bell or buzzer, as described, and with silk-wound induction coils with fibre heads. It has a long lever gravity hook, with platinum contacts. It is furnished with any kind of backboard desired, and is of heavily enameled black metal.

The instrument shown in Fig. 3 is one with which the Haines & Noyes Company states it has had much success in equipping hotels throughout the country. It is for interior use only, and contains several special features. It is furnished with a hard-rubber water-shrunk bipolar receiver and standard transmitter, with a heavy

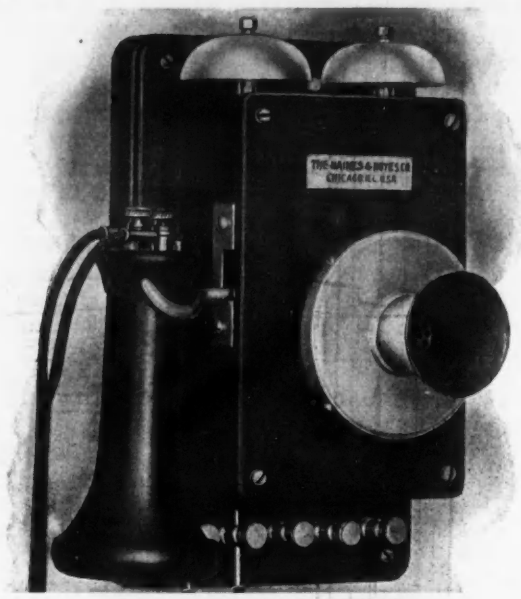
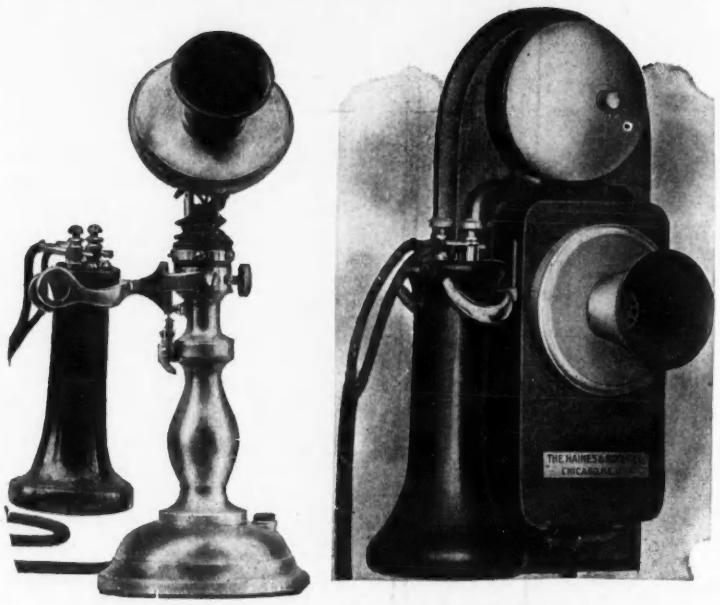


FIG. 2.—INTERIOR TELEPHONE.

brass cast front, and contains a long lever gravity hook with platinum contacts. The backboards are furnished in ebony, oak, mahogany or walnut, as desired. It may be had with single gong vibrating bell or buzzer.

The Haines & Noyes Company makes a specialty of private telephone plants for hotels, offices, factories, hospitals, private residences, steam and electric railroads, etc.



FIGS. 1 AND 3.—DESK AND INTERIOR TELEPHONE.

A New Departure in Chandelier and Ceiling Fan Combinations.

The accompanying illustrations show exterior and sectional views of an interesting and novel combination ceiling fan and chandelier made by the Boston Electric Heating & Power Company, Boston, Mass. Fig. 1 shows an external view of the combination, while in Fig. 2, to the lettering of which reference is made below, is shown the interior and working parts, *A* being the yoke, *B* the resistance, *C* the snap switch, *D* one of the live rings by means of which the electrical connections are made; *E* the guide bearing running in the oil cup *F*, *G* the bracket arm of the chandelier, *H* the oil tube shown open for insertion of oil; *J* the hardened steel washer of the lower or working bearing upon which the step runs, *K* the fan attached to

the lower end of the hollow shaft, and *L* the thumb nut attached to the switch spindle which projects downward through the hollow shaft.

The yoke *A* is attached to an ordinary pipe hanger at its upper end, and to its lower end is attached the motor and working parts. Attached to this yoke, but insulated from it, are two metal rings with suitable binding posts to which the line wires are attached and which are carried to the switch, motor and electric lights in the arms. By this arrangement the wiring which, in a four-arm chandelier, would otherwise be complicated, is of the simplest construction. Within the yoke is hung the switch, which, with the resistance, gives two speeds, found in practice to be ample in this style of fan. Full speed is about 650 r. p. m., slow speed about 450 r. p. m. Attached to the hollow shaft is the hardened tool steel step *E*, having a downwardly projecting flange which enters the composition cup *F* in such a manner that while guiding the shaft it aiiows no portion of the shaft to touch the bearing. The well in the center of this composition cup *F*, together with the holes in the flange, prevent any oil from working up the step and thence onto the shaft and downward into the motor. The arrangement of the oil tube is such that oil may be inserted until it overflows at the point of insertion, without a possibility of any flowing into the well in which the shaft runs. As the upper and lower bearings are practically alike, it will be seen that no matter how careless the oiling, there is no danger of getting oil into the motor or throwing it from the pan.

FIG. 1.—VIEW OF COMBINATION.

The lower bearing is provided with the hardened steel washer *J*, upon which the flange of the step rests, thereby supporting the entire load of the shaft and fan. The fan consists of upper and lower spun brass disks, the upper disk having an opening in the center for the inlet of its air supply. These floats are arranged vertically about the center of rotation. The lower disk is attached to the hub, which in turn is attached to the hollow motor shaft. This arrangement of disks and floats forms a noiseless centrifugal fan of such shape that when it is revolved the air is delivered outward and downward in the form of a cone. An 18-inch fan will cover, with a sufficient breeze, an area 18 ft. in diameter.

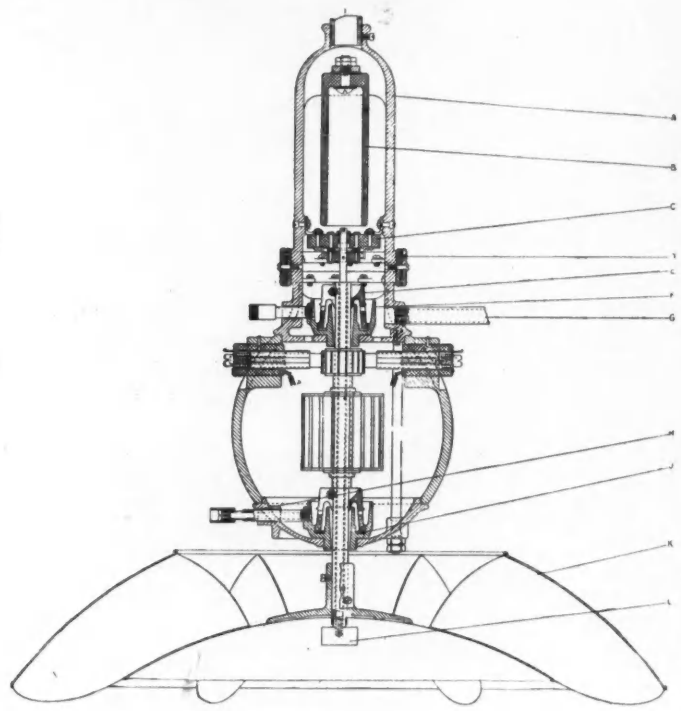


FIG. 2.—SECTIONAL VIEW OF COMBINED APPARATUS.

New Factory of the Strowger Automatic Telephone Exchange.

In January, 1901, the Strowger Automatic Telephone Exchange moved its factory from Boston to Chicago, bringing the factory to the home office of the company. The magnitude of the automatic switchboard business will be a surprise to many, and is well illustrated by the accompanying view of the assembling room in the new factory. Secretary Harris reports that a force of 300 men is now worked night and day. The factory is working on a 15,000 subscriber board for Havana, Cuba, for the Red Telephonica, and also on boards to take care of 30,000 subscribers for the Illinois Telephone & Telegraph Company, of Chicago. The Strowger Automatic system is used in Washington on the exchange connecting all of the principal Government departments, and is becoming very popular in Berlin.

FIG. 1.—STROWGER TELEPHONE FACTORY.

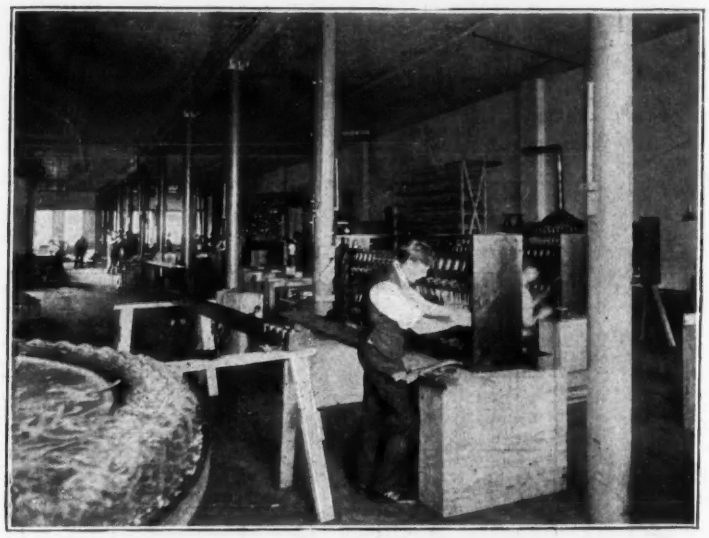


FIG. 2.—STROWGER TELEPHONE FACTORY.

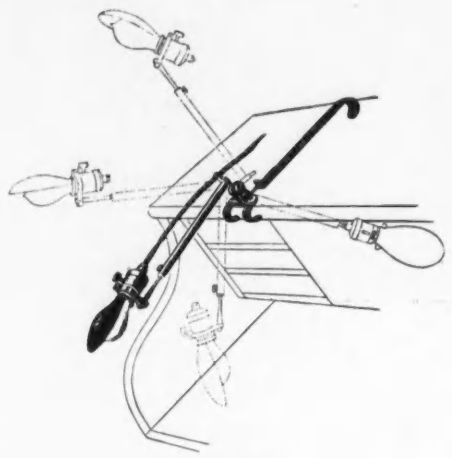
An Exchange for Party Line Service Only.

Springville, in New York State, offers something which is unique and novel in the independent telephone field, and that is an exchange which is composed entirely of party lines. The Springville Telephone Company organized and commenced operation October, 1900. As it was compelled to meet active party line competition from the Bell Telephone Company, it decided to face it with a like system, and cast about to see if they could not furnish its patrons a better service. After investigation it placed the contract with the Sterling Electric Company, of Lafayette, Ind., for equipping the exchange

with their entire apparatus, consisting of switchboards, protective devices and selective signal non-interfering telephones. It has to-day in operation 150 subscribers, each one of whom is upon a selective signal party line. Its service is in every way satisfactory to its patrons, and its treasurer, Dr. Waite, writes that, in his opinion, it could not be improved upon. He deems the selective signal telephone the coming instrument of to-day. The company is enjoying rapid growth.

A New Desk Lamp.

The Smith & Hemenway Company, New York City, is introducing the Ferguson adjustable lamp bracket, one of the most novel and up-to-date roll-top desk lamps on the market. It is adjustable to any size rolltop desk or upright piano, and can be fastened on without the assistance of screws or nails. The reflector can be



DESK LAMP.

placed at any desired angle to prevent a glare in the eyes. It is ornamental and handsomely finished in enamel and nickel, and at the same time very durable. It is simple in construction and operation, and is quickly adjusted. There are no springs to get out of order or make bad contact. The accompanying cut illustrates a few of the angles at which it can be placed.

Telephone Call Registers.

The American Toll Telephone Company has lately added to its already complete line of pay stations a new call register for measured service. The Bell Companies have for years considered this part of their service very profitable to them, and these small instruments are in use in very large numbers. As yet the independent companies have not had access to an instrument of this kind, but the above company has already taken large orders for its machine from them. It is built on different lines from the register used by the Bell companies. It cannot be tampered with in any way, and it is impossible to obtain signals by rapping the box on the side.

CALL REGISTER.

Many telephone companies are now advertising measured service at the rate of 600 calls for 3 cents per call, all over and above that at 5 cents per call. This call register notifies the operator, and also keeps an accurate account of all outgoing calls, thus saving all disputes between subscriber and central, as the register is in plain view of the subscriber. This part of the telephone service is one that may be investigated by independent companies with much profit to themselves and satisfaction to patrons. The instruments can easily be attached to any telephone.

Washington to Baltimore by Automobile.

A Mark XII. Columbia runabout, owned by Mr. George Howard, treasurer of the National Safe Deposit, Savings & Trust Company, of Washington, D. C., and equipped with new Exide battery, made the trip from Washington to Baltimore on one charge, last Wednesday, May 29, under conditions that made the trip a remarkable one from the point of battery endurance. An automobile run had been planned from Washington to Baltimore that day, but the falling rain and heavy condition of the roads kept every vehicle from starting except the Columbia runabout, in which were Otto Jacobi and Chas. Baxter. When Baltimore was reached the cyclometer indicated a run of 44 miles, and 8 miles of this distance was over roads that required an excessive amount of current to keep the vehicle in motion. This section of the road is described as one of layers of mud and sand over rough fillings of broken stone. In some places the mud was so deep that the motor was covered. There was sufficient current left to carry the vehicle several miles around Baltimore when the vehicle reached that city, bringing the total mileage on one charge of the batteries to 50. The condition of the roads prevented any attempt at speeding.

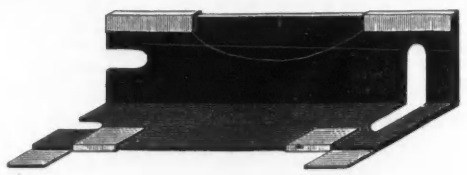
A New Telephone Renewable Fuse.

The Sterling Electric Company, of Lafayette, Ind., which is one of the largest manufacturers of telephone apparatus in this country, has added to its already complete line of equipment something new in the shape of a renewable fuse. In the manufacture of its different protective devices it discovered that many fuses offered upon the market were not substantial and easily broken before operating. Consequently, it has perfected a fuse which is virtually indestructible, 100 per cent of which are always ready for use, regardless of their handling, and one which can be re-fused, as its operation does not destroy anything but the fuse wire itself. These are made in standard sizes of 1½ to 4 inches, either of the Western Union or

W. U. TYPE OF FUSE.

Postal type, the fuse wire having a capacity of from ⅛ of an ampere to 2 amperes.

The body of this new article is made of black fibre, so creased that it can be folded in a book form. This body is tipped with copper. The fuse wire is soldered between the copper tips upon the inner side of the fibre folder. After being fused it is folded together and clamped with a portion of the copper tip. In this way the fuse wire



POSTAL TYPE, OPEN FOR REPAIRS.

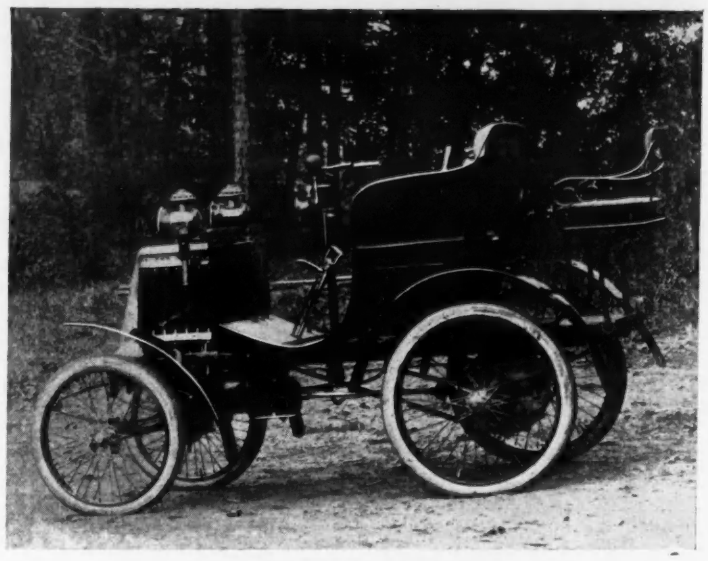
is always enclosed in slack form. It admits of cleaning, bending, twisting or rough handling, without destroying the fuse.

In the operation of the fuse, in the case of the action of electric current, the fuse wire only is destroyed. The folder can be reopened and new fuse soldered to place between the terminals. Telephonists can readily see the practicability of this device and the large saving due to the fact that 100 per cent are good to start with, regardless of the handling, and that the devices are readily re-fused at practically no expense. We show the Postal and Western Union types of the standard 2-inch fuse opened for repairs, and also a cut of the device fused ready for service.

A Tourist Motor Car.

Mr. H. Ward Leonard, the well-known electrical engineer, has of late devoted considerable attention to automobile work, favoring specially vehicles of the gasoline type, and the result is already seen in some new types of great interest, one of which we illustrate.

Mr. Leonard investigated the subject thoroughly in France and



CENTURY TOURIST MOTOR CAR.

England in 1894 and also in 1895. Last year he decided to undertake to manufacture an automobile, and spent several months investigating the various types abroad, especially those in France. He finally decided to manufacture the present car, which is almost identical with the "Reynault" car, which has made such a fine showing in the various races during the last summer, especially the 800-mile race from Paris to Toulouse and return upon which occasion this car made an average speed of 24¼ miles for the 800 miles, when equipped with a 5-hp De Dion-Bouton motor.

He makes this car in two sizes, one of which is equipped with a 3½-hp water-cooled De Dion-Bouton motor and the other which is equipped with a 5-hp water-cooled De Dion-Bouton motor. He will also place on the market this summer a still larger car equipped with a 6½-hp motor, the arrangement of the machinery being practically the same as in this car, but the car being a larger one and suitable for carrying four passengers.

The car shown in the cut when equipped with a 3½-hp motor will make about 25 miles per hour on a good level road, and upon the average American roads will keep up an average speed up hill and down of about 15 miles per hour. When equipped with a 5-hp motor the maximum speed on a level road is between 30 and 35 miles per hour, and the average speed up hill and down on ordinary roads will be between 20 and 25 miles per hour.

One of the strongest points in this car is the very flexible arrangement of the engine relative to the back axle, and the extremely easy springs with which the car is provided. All parts of the mechanism that require any possible attention are extremely accessible at the front of the car, and all of the moving machinery; that is, the engine, variable gear and the back axle gear, are all enclosed in dust-proof metal boxes, with all the mechanism running in a bath of oil. The car is one of the most noiseless. Upon all level roads, and when the grade is 4 per cent or less, there is no variable gear in motion, the transmission of power being direct from the engine to the back axle. This reduces the amount of wear of the mechanism, results in a great saving of power, and also greatly reduces the noise under the usual condition of operation.

The Shanghai, China, Telephone Exchange.

While China is one of the largest countries of the world in point of area and population, it is backward in many respects in adopting the improvements of modern times. With very few railway and telegraph lines, it has fewer telephone lines or exchanges. By courtesy of the Ericsson Telephone Company, 296 Broadway, New York City, we illustrate the first sections of a telephone switchboard installed at Shanghai, China, and recently placed in operation. This is a full multiple board, made by L. M. Ericsson & Co., Stockholm, Sweden, and the ultimate capacity is 5000 subscribers. Our readers will observe that while the "chief" is a lady operator, and was imported from Sweden with the switchboard, the others are all natives. It is said that they are remarkably apt in learning to operate, quick in their movements, and naturally patient and persistent, and they readily become expert operators.

The operation of the Ericsson full multiple switchboard is extremely simple, each section being divided into five panels for convenience, and in large boards an annex is placed at each end. The plugs and cords are placed on two different planes, the answering below and the calling above, which is of great advantage to the operator as the answering jacks are just above the answering plugs, thus separating them entirely from the calling plugs and multiple jacks. In case of a call the operator answers and can connect directly from her own division with any other subscriber in the board, thus giving very quick service and saving the time of the calling subscriber and of the other operators.

Each operator has 18 pairs of cords and plugs, which provides for the busiest exchanges. The board is so made that busy subscribers' lines can be removed from one operator to another, thus distributing the work quite evenly. Each operator has a counter, which records automatically all the outgoing calls from her division of the board. It is said that this will be made a model exchange, and additional sections are on the way to Shanghai now, which will increase the size of the board. Other sections are to be supplied as may be required. As switchboards of this same pattern are already in operation in this country, the Ericsson Company will take pleasure in giving further information to those who are interested.

TELEPHONE EXCHANGE, SHANGHAI, CHINA.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money on call closed at 2 per cent, nominally. Time money was easier, the rates being 4 per cent for 30 days to 6 months. There was a better demand for mercantile paper, the closing rates being 4 per cent for sixty to ninety days' endorsed bills receivable; 4 a 4½ for choice four to six months single names, and 5 a 6 for others. In the stock market there was greater activity and prices advanced, although the public is slow in entering the speculative market. The renewed interest in railroad stocks stimulated other securities. United States Steel stocks advanced in sympathy with the main market and on dividend rumors. Metropolitan Street Railway was the active feature in the traction group, on the anticipation of increased earnings on the Broadway line under electric operation. This stock closed with a net gain of 4¼ points. Brooklyn Rapid Transit made a net gain of 6 points on somewhat diminished trading, the sales aggregating 72,047 shares. In the electric list General Electric stands at the head in activity. The number of shares sold was 10,150, the net gain in price on the week's business being 10¼ points. Western Union also shared in the general advance, closing with a net gain of 2¾ points. There was active trading in this stock, the shares sold being 20,900. In the market for outside securities the general tendency of prices was upward, although the volume of trading was exceedingly limited, except on the last two days of the week. Following are the closing prices at New York, Boston, Philadelphia and Chicago:

NEW YORK.

	May 25.	June 1.		May 25.	June 1.
General Electric	223	233¼	Electric Vehicle	11½	11
Brooklyn Rapid Transit	75⅝	81⅝	Electric Vehicle, pfd	18	17
Metropolitan Street Ry	169¼	173½	General Carriage	2	2
American Tel. & Cable	99¼	99½	Illinois Elec. Veh. Tran	⅞	⅞
Western Union Tel	92	94¾	Hudson River Tel	120	120
American Dist. Tel	—	—	N. E. Elec. Veh. Tran	3	3
Commercial Cable	—	—	N. Y. Elec. Veh. Tran	1⅛	1
Electric Boat	15	19	Tel. & Tel. Co. of Am	5	5
Electric Boat, pfd	40	45	N. Y. & N. J. Tel	169	169
Electric Lead Reduc'n	3½	3½			

BOSTON.

	May 25.	June 1.		May 25.	June 1.
New England Telephone	—	—	Erie Telephone	58	58½
Mexican Telephone	2½	2¾	General Electric, pfd	—	—
Westinghouse Electric	63	64¼	Am. Tel. & Tel	180	173½
Westinghouse Elec., pfd.	—	—	Boston Electric Light	*240	240*

PHILADELPHIA.

	May 25.	June 1.		May 25.	June 1.
Electric Storage Battery	63	53	Philadelphia Electric	5⅞	5¾
Elec. Storage Batt'y, pfd	60	60	Pa. Electric Vehicle	1¼	1
Elec. Co. of America	9	8	Pa. Elec. Veh. pfd	1	1
General Electric Auto	—	—	Am. Railways	45¾	45

CHICAGO.

	May 25.	June 1.		May 25.	June 1.
Chicago Edison	*175	173	Chicago Telep. Co	260	260
Chicago City Ry	255	255	Union Traction	16½	18¼
National Carbon	15⅞	15⅞	Union Traction, pfd	57½	58
National Carbon, pfd	83	83	Northwest Elev. com	49½	49

*Asked.

WASHINGTON TRACTION.—Announcement of default of interest and plans for reorganization of the Washington Traction & Electric Company was issued last week by the majority bondholders. The Reorganization Committee consists of George W. Young, chairman; John C. Brown, James Timpson, William H. Hollister, Gardiner M. Lane. The offices of the Bondholders' Committee will be at No. 59 Cedar Street, New York. The Washington Traction & Electric Company controls all the electric railways in the District of Columbia except the lines of the Capital Traction Company. It also controls the electric lighting plants. The stock and bonds of the company are mainly owned by New York people. The action was the result of a conference of persons interested in New York. The failure to pay the interest renders the company liable to foreclosure. The earning capacity never has been equal to the demands. The company was organized two years ago with a capital of $12,000,000 in stock and $20,000,000 in 4½ per cent bonds. Its property consists of the stocks of eleven street railroads and two electric lighting companies in Washington. The deficits in the company's revenues have been made good at each successive period by those largely interested, and, it is understood, through an assessment on the stock. The present action is attributed to some large holders, including Messrs. Hayward, of Baltimore; Scott, of Wilmington, Del., and F. C. Stevens, of Washington, selling their stock. The purchasers, it is reported, are the Roeblings, of New York. It is supposed that a floating debt has been accumulated. Some conjecture that this has reached $1,000,000 or more. Mr. George W. Young, one of the majority bondholders, estimated that it would be four or five years before the receipts of the company on its present basis would meet the operating expenses and fixed charges.

SEATTLE-TACOMA INTERURBAN RAILWAY.—A syndicate has been formed in Boston to build an electric railway between Seattle and Tacoma. Lee, Higginson & Company, Kidder, Peabody & Company, J. M. Forbes & Company, and Stone & Webster are members of this syndicate and all the securities have been placed. The road will be 33 miles long and the construction similar to steam railroad construction. Electric cars will be run at high speed, the equipment being able to run at 60 miles an hour, so that people doing business in one city will be able to live in the other. The capital stock will be $2,000,000; there is also an authorized bond issue of $2,000,000, of which $1,350,000 will be issued at once. Stone & Webster have secured enough franchises, rights of way and contracts to proceed immediately with the construction. Rails have been ordered and work has begun. The first instalment of 20 per cent on the subscriptions was paid by the syndicate May 10. Several experts from the office of Stone & Webster visited the Pacific coast within the last few months and have all come back enthusiastic about the prospects of this road. Seattle increased 88 per cent in population in the past decade and bids fair to better this in the next. Tacoma is also showing remarkable increases in all lines of activity.

LOUISVILLE'S LIGHTING INTERESTS.—It is stated that Anthony N. Brady, of New York, is the leading spirit in a consolidation of the light, heat and power interests of Louisville, Ky., in the new Citizens' Lighting Company, which has been incorporated under the laws of Kentucky with a capital of $1,000,000. The present companies to be merged in the new concern are the Citizens' General Electric Company and the People's Electric Light Company. The capital stock of the Citizens' General Electric Company is 679 shares of preferred at $100 and 4974 shares of common, which are to be converted ratably into 9724 shares of stock and $500,000 bonds in the new company, and in addition $15,000 in cash is to be divided ratably among the preferred stockholders. The 150 shares into which the capital stock of the People's Electric Light Company is divided are to be converted ratably into 276 shares of the new company. It is said that new machinery will be installed and that the territory covered by the old companies will be considerably extended.

WESTERN UNION RIGHTS.—The following financial item gives a pretty good idea of the idiocy of much of the trading that goes on in Wall street: "The market for 'Western Union rights,' securities that the curb brokers in Wall street deal in when times are dull and victims are handy, was on the boom yesterday. Amid a great deal of excitement and heavy trading the price of the rights rose from 12½ to 18¾, later, however, reacting and closing at 13. Several of the outside brokers placed large orders to buy the rights with the curb representatives of F. J. Lisman & Company and J. H. Olyphant & Company, and it was the bidding of these two brokers that advanced the price. Some of the most prominent houses in the Street, these brokers were told, were behind the orders. Both brokers have been trading on the curb but a short time, and when they came to report their purchases to their respective offices they learned for the first time that all the rights represent is the right to lean against a telegraph pole."

THE AMERICAN RAILROAD COMPANY, whose stock has been selling upon the curb recently in New York city, has placed an order for steel engraved certificates with the International Bank Note Company with directions that they be prepared to meet the requirements of the New York Stock Exchange. The company's officers decline to talk for publication, but it is said that large operations centering in New York, Philadelphia, Atlantic City and Chicago are under way. The declared purpose of the company is to build an elevated electric system over existing steam lines for express passenger service with practically any limit of speed as their cars cannot leave the track. Large sums have been spent in perfecting the system on an experimental line and it is now ready to operate.

AMERICAN TELEPHONE & TELEGRAPH.—Directors of the American Telephone & Telegraph in voting to offer stockholders $21,000,000 of stock at par, are presenting them with a very substantial bonus. Present stockholders will have the right to take one share of new stock at par for three now held at 181 for American Telephone. The "right" is figured to have a value of $20. The American Telephone & Telegraph Company has filed a certificate of increase of capital stock from $100,000,000 to $150,000,000. The amount of stock actually issued is $94,237,500. The certificate is

signed by Alexander Cochrane, chairman, and Charles Eustis Hubbard, secretary of the meeting at which the increase was authorized.

PITTSBURG CONSOLIDATED TRACTION.—The plan for the consolidation of the Philadelphia Company and the Pittsburg Consolidated Traction Company will, it is said, provide as follows: Philadelphia Company stock to get 50 in a 5 per cent bond and a certain amount of 5 per cent preferred stock and of common stock, the amount of preferred being more than 20 per cent. Pittsburg Consolidated Traction to get 25 in a 5 per cent bond and a certain amount of 5 per cent preferred and of common stock. It is stated that no new cash capital will be required.

CHICAGO ELEVATED CONSOLIDATION.—President Mitchell, of the Illinois Trust & Savings Bank confirms the report that the Northwestern Elevated has purchased the Union Loop, paying $125 per share for the stock. With the new bonds the total bond issue of the two companies will be $15,600,000. The present earning capacity of the two roads would give 5 per cent. on the preferred stock and 1½ on the common.

CHICAGO TELEPHONE COMPANY.—Directors of the Chicago Telephone Company have voted to issue, on October 1, $1,000,000 of additional stock at par to stockholders of record on Sept. 26 on the basis of one share for each eight shares of their old stock. This will make the outstanding capital $9,000,000. Chairman Clark said at the annual meeting that $2,000,000 more stock would be issued this year.

Commercial Intelligence.

THE WEEK IN TRADE.—The wet, unseasonable weather had a somewhat discouraging effect in many lines of commerce, particularly in agriculture, yet there is a general hopeful feeling that sunshine will dissipate all such depressing features. Apart from this, the week was one of little change, except that a somewhat better spirit was shown in the industrial situation, and that some progress was made toward a settlement of the existing labor difficulties. In the iron and steel trade, practically the same conditions as those noted last week still prevail, namely, little new business, while the production on orders is at the maximum. Finished products are generally strong, and the mills are still crowded with business. Railroad earnings continue satisfactory. For the second week in May 55 roads report gross earnings, aggregating $8,716,538, a gain of 9.9 per cent over the earnings during the same period last year. The failures during the week, as reported by *Bradstreet's*, numbered 144, against 192 the week previous, and 135 the corresponding week last year. In the New York metal market copper was extremely dull, but prices were kept at the same level as they have been for the past several weeks. The principal producing interests are still holding Lake at 17c. and electrolytic and casting at 16⅝c.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical material, from the port of New York, for the week ended May 22: Antwerp—12 packages electrical material, $808; 90 packages electrical machinery, $6,872. Athens—9 packages electrical material, $268. Argentine Republic—201 packages electrical material, $7,228. British Australia—5 packages electrical material, $69. British East Indies—49 packages electrical material, $3,635; 35 packages electrical machinery, $8,998. British Guiana—17 packages electrical material, $1,261. Budapest—4 packages electrical material, $203. Bremen—1 case electrical material, $105. Brazil—143 packages electrical material, $1,633. British West Indies—2 packages electrical machinery, $231; 1 case electrical material, $11. Brussels—1 case electrical material, $5. Cuba—124 cases electrical material, $4,020. Chili—15 cases electrical material, $174. Christiana—4 cases electrical material, $20. Copenhagen—1 case electrical material, $25. Central America—12 cases electrical material, $237. Dundee—1 package electrical material, $4. Dutch East Indies—4 packages electrical material, $51. Equador—10 cases electrical material, $300. French Possessions in Africa—2 cases electrical material, $20. Glasgow—36 packages electrical material, $5,000; 19 packages electrical cable, $4,750. Genoa—105 cases electrical material, $7,997; 1 case electrical machinery, $150. Gibraltar—2 cases electrical material, $40. Hamburg—39 cases electrical material, $1,286. Havre—72 packages electrical material, $2,215; 3 packages electrical machinery, $360. Japan—223 packages electrical material, $17,457; 136 cases electrical machinery, $25,613. Lisbon—87 packages electrical material, $9,977; 6 packages electrical cars, $35,924. Leeds—4 packages electrical material, $710. Liverpool—132 packages electrical machinery, $12,154; 14 packages electrical material, $602. London—191 packages electrical machinery, $22,183; 111 packages electric material, $6,047; 24 rolls electrical cable, $4,504. Marseilles—6 cases electrical material, $500. Manchester—105 packages electrical material, $15,432. Mexico—7 cases electrical material, $1,183. Naples—2 cases electrical material, $77. Preston—1 package electrical material, $30. Philippines—51 packages electrical material, $1,001. Peru—7 packages electrical material, $270. Stockholm—7 packages electrical machinery, $800. Southampton—3 packages electrical material, $300; 6 cases electrical machinery, $1,166. Siam—63 packages electrical material, $3,009. U. S. Columbia—13 packages electrical material, $569. Uruguay—12 cases electrical material, $238. Venezuela—33 packages electrical material, $460.

MINING IN ARIZONA.—An electrical generating plant will be established on the Salt River, which runs through a great copper belt of eastern and central Arizona. Wires will be strung in all directions of from thirty to sixty miles to mining camps. The engineer states in his report that the waters of the Salt River at any season are capable of generating more than 3000 horse-power. The plant will be finished within fourteen months, and contracts are new being made with the principal consumers of power along the route outlined for the delivery of power at the end of eighteen months. The territory embraced by the projected system contains very rich copper deposits and liberal bodies of silver, gold, and galena. At Globe, where wires will first be run, are located the Old Dominion and United Globe copper mines; and a few miles away is the Black Warrior, a new property that is now coming into great prominence. Many million dollars have been taken out of the established mines at Globe, but the output has been unsteady because of the uncertainty of a supply of coal for fuel purposes. Electricity is expected to render the output more constant. In the Mineral Creek district, where the Ray Mine Company, limited, an English corporation, has spent in the neighborhood of $1,500,000 in opening a copper deposit, electric power would overcome serious obstacles. A number of gasoline engines were put in, but they failed to perform their work. This scheme of the San Francisco company seems likely to be the first enterprise of several of the kind to be completed in Arizona.

THE NATIONAL BRIDGE COMPANY has been recently incorporated under the laws of the State of New York; capital stock, $200,000. The purpose of the organization is to construct bridges, more especially highway and electric railway bridges, also steel and iron structural work. The company has already acquired two first class plants, and is prepared to take orders for immediate work, and has, it is reported, a large stock of material on hand. The officers of the company are W. N. Conger, president; A. A. Miller, vice-president; C. W. Smith, secretary; George T. Bacon, treasurer. The general offices of the company are at 45 Broadway, New York.

THE SAFETY INSULATED WIRE & CABLE COMPANY, of New York City, reports that contracts for two buildings, 500 feet by 50 feet each, for its new plant at Bayonne, N. J., have just been let, and that work will begin on them this week. The new dock has now been completed. The buildings referred to will be completed inside of four months. Contracts for boilers, engines, pumps, etc., for installation in the Bayonne works, are expected to be alotted shortly. The company is now busily engaged in completing the 1000-mile submarine cable contract, which was recently received from the United States Government for the Philippines.

J. B. & J. M. CORNELL, of this city, are at present making considerable extensions to their Cold Springs, N. Y., plant, in view of having recently undertaken some substantial contracts for castings required for large marine engines about to be installed in double screw ships now under construction at the New York Shipbuilding Companies' yards, Camden, N. J. The Cornell people will require a fair-sized lot of electrical machinery. So far, contracts have been alotted to the Crocker-Wheeler Company for several motors of various sizes, to be utilized for operating cranes and machine tools.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY is about to make shipment of ten carloads of various electric material for the Borough of Salford, England, electric traction system, part of the contract for which was recently undertaken by the British Westinghouse Electric & Manufacturing Company. The value of the shipment is about $50,000.

THE MORGAN-GARDNER ELECTRIC COMPANY, of Chicago, is reported to have secured a large order for electrical mining machinery, to be utilized in the mines of the Compagnie des Forges de Chatillon, near Nancy, France. The Chicago concern has been making some heavy shipments of such equipment to Liverpool for some time past.

LAMBERT SCHMIDT TELEPHONE MANUFACTURING COMPANY, 325 Broadway, New York, has just purchased all the tools and material of the Bruckner Electric Company, and has added the equipment to that of its own factory, which gives it now exceptional facilities for the rapid output of telephone apparatus in large quantities.

EXETER MACHINE WORKS, of Pittston, Pa., are installing a complete coal handling system for the Oxford Paper Company, Rumford Falls, Me., including electrically driven crushers and the Exeter LeGrand conveyors.

RECENT STERLING EXCHANGES.—The Sterling Electric Company, of Lafayette, Ind., reports the following recent orders filled for telephone switchboards ranging from 50 to 1000 lines: Marietta, Ohio; Tremont, Ill.; Cambridge, Ill.; Pittston, Pa.; Decatur, Ill.; Ottumwa, Ia.; Sharon, Wis.; St. Joseph, Ill.; Cheboygan, Mich.; Maglehurst, Miss.; Greenville, N. C.; Brandenburg, Ky.; Freeport, N. Y.; Columbus, Miss.; Long View, Texas; Meadville, Pa.; Fithian, Ill.; Hoopeston, Ill.; Racine, Wis.; West Point, Ind.; Sidney, Ill.; Junction City, Kan.; McConnellsville, Ohio; Jermyn, Pa.; Iowa City, Ia.; West Liberty, Ia.; Greenup, Ill.; Monmouth, Ill.; Milton Junction, Wis.; Auburn, Ind.; Kendallville, Ind.; Nevada, Ia.; Kempton, Ind.; Topeka, Ind.; Champaign, Ill.; Burr Oak, Mich.; Mount Ayr, Ia.; Columbus, Kan.; Cerro Gordo, Ill.; Manito, Ill.; Attica, Ind.; Duncan, Indian Territory; Pekin, Ill.; Wilkesbarre, Pa.; Browns Valley, Ind.; Anderson, Texas; Crawfordsville, Ind.; Warren, Ark.; Winterset, Ia.; Cairo, Ill.; Wolcottville, Ind.; Monticello, Ind.; Stockwell, Ind.; Rochester, Ind.; Marshall, Ill., and Lima, Ohio. The Sterling Electric Company reports also that it is unable to fill orders for its well known protective devices and cable terminals, consequently is largely increasing its machine capacity so as to enable it to cope with the rapidly increasing business.

POWER IN NEBRASKA.—With regard to water power in Nebraska, the Niobrara *Pioneer* says: "The Niobrara River and Bazile and Verdigris creeks are very swift streams, furnishing many excellent mill sites and unlimited water power. The Niobrara Irrigation & Water Power Company, with a capital of $60,000, was organized March 21, 1901, and a survey at once begun. In a distance of five miles it has a fall of 52½ feet. The engineers in charge are Arnold C. Koenig and Charles A. Nippell, and Prof. Stout made the river gauging, finding at a normal stage 1600 cubic feet per second passing the head of the proposed canal. The canal will be constructed during the present summer of 1901 and 2500 horse-power developed. The officers are: B. Y. High, president; G. G. Bayha, vice-president; G. W. Chambers, treasurer, and E. A. Fry, secretary. Only a few of the many fine powers have, as yet, been developed, but the near future will display numerous examples of their utility to man when properly harnessed. The northern part of the county lies over the great artesian basin and several wells have been bored that flow with a pressure of ninety pounds to the square inch. The flouring mill, electric light, water works and small motors are run by the power of one artesian well.

THE BROWN-CORLISS ENGINE COMPANY, incorporated at Milwaukee, Wis., with a capital stock of $1,000,000, has already organized and got down to business. Mr. Julius Wechselberg is president; Mr. Walter F. Brown, formerly of the Harris Corliss, the Allis and the Filer & Stowell companies, is general manager and second vice-president. Mr. Walter S. Whitings, the first vice- president, is the son of the general manager of the Calumet & Hecla copper mine, and is a brother of Mr. C. W. Whitings, formerly with the E. P. Allis Company. The new concern has bought 1200 acres of land at Western Union Junction, Racine County, Wis., and is laying out a manufacturing city to be called Corliss. The factory is to employ 500 men as a starter. There will be a machine shop 500 feet long and 125 feet wide, and a foundry 400 feet long and 120 feet wide. All the buildings will be of steel and brick and replete with the latest tools and labor saving machinery. It is expected that the new company will play an important part in engine construction.

A FOREIGN VIEW OF COPPER PRICES.—The London *Statist*, discussing the statistical position of copper, concludes that though there may be no immediate appreciable decline in the price, yet with the growth of production and check to consumption, especially in Europe, the outlook is for difficulty in maintaining the price of copper at £70 per ton for "standard." Consumption in Europe this year has diminished 20 per cent from 1900, and with this decrease there has been restriction in American exports. The *Statist* thinks it likely that if, by reason of high prices, consumption continues checked and production continues to expand, there is danger of defection of some of the larger companies from the policy of restriction and control exercised by the American syndicate.

LARGE STOKER ORDER.—The Metropolitan Street Railway and Edison companies of Kansas City have just placed what is said to be the largest stoker order ever given in this country outside New York. Mr. P. Albert Poppenhausen, manager of the Green Engineering Company, of Chicago, has sold them 24 Green traveling link grates aggregating a capacity of 12,000-hp. This is the third order from the same quarter and makes a total of 15,000-hp. Other large plants with the Green apparatus are the Milwaukee Electric Railway & Light Company, 4000-hp.; Chicago Union Traction Company, 8000-hp; St. Louis Transit Company, 16,000-hp; Steubenville Traction & Light Company. The Green Engineering Company reports total sales since Jan. 1, 1901, of 27,000-hp.

PURCHASING FOR THE CAPE.—Mr. Charles Bletterman Elliott, of Cape Town, General Manager of the Cape Government Railways, who arrived last week at Southampton, was interviewed by a representative of the *Daily Mail* concerning his mission. This is to purchase material for South African railways. Mr. Elliott said he would remain in England for several weeks, and then go to the Continent and the United States. He added: "I shall devote special attention to the equipment of narrow-gauge roads, and, while in the United States, to the electric lighting systems. I shall prefer to give British manufacturers the preference if their terms and materials are satisfactory, but we must have the best and cheapest equipment it is possible to obtain."

DEMAND FOR ELECTRIC MACHINERY IN SPAIN.—Consul-General Guenther, of Frankfort, under date of April 27, 1901, says that a new electrical company, the "Sociedad General Gallego de Electricidad," has just been formed in Madrid, Spain, with a capital of 2,000,000 pesetas, and two of its engineers, Messrs. Ernesto Presser and Adoolfo Barbe, of Madrid, have been instructed to procure the necessary machinery, etc. Another company has also been formed at Saragossa—the "Sociedad de Aprovechamiento del Rio Gallegos—with a capital of 3,500,000 pesetas. This company will require a great deal of machinery and apparatus.

CAPE FEAR POWER PLANT.—Work has been begun upon the Cape Fear power plant at Buckhorn Falls, North Carolina. The contract for the electric equipment has been awarded to the General Electric Company and for turbines to the S. Morgan Smith Company, of York, Pa. The contract for the insulators, etc., has been awarded to the R. Thomas & Sons Company, East Liverpool, Ohio, and for the transmission lines, which will be 36 miles long, to Mr. John Blair MacAfee, of Philadelphia. Messrs. W. A. Smethurst and Rodney D. Allen will be the engineers, representing Mr. MacAfee in the construction of the transmission line.

ELECTRICITY IN RAILROAD SHOPS.—The Lake Shore & Michigan Southern Railroad Company, which is building extensive shops near Cleveland, has placed contracts for one 400-kw and one 75-kw Crocker-Wheeler generator; one 600-hp and one 125-hp Buckeye engine and 1200-hp of Aultman-Taylor water tube boilers. Contracts for the structural work of the blacksmith shop, locomotive machine shop and power house has been placed with the American Bridge Company.

THE WILLIAM TOD COMPANY, of Youngstown, Ohio, is letting contracts for the erection and equipment of what will be one of the largest foundries in the country. It will be devoted to the production of heavy machinery castings and will be equipped with modern electrical appliances. A contract has been placed with the Penn Bridge Company, of Beaver Falls, for the structural work for the building, which will be 80x400 ft. and 45 ft. high.

ELECTRIC RAILWAY CONTRACTS IN OHIO.—Contracts have just been let for power-house equipment of the Cincinnati & Eastern Railway, the new electric line connecting with New Richmond, as follows: Motors and generators, Westinghouse Company; engines, Buckeye, two of 600-hp each; boilers, the Aultman, Taylor Company, four, each of 300-hp. Car contracts will be taken up within the course of two or three weeks.

ENGINES FOR GENERATING PLANTS.—The Jones Brothers Electric Company, of Cincinnati, Ohio, has ordered a 450-hp tandem compound engine, arranged for direct connection to generator, from the Bell Engine Company, Erie, Pa. The Dayton, Ohio, Malleable Iron Works has also purchased a 175-hp engine, arranged for direct connection to generator, from the Ball Engine Company.

NEW YORK FIRE DEPARTMENT.—Mayor Van Wyck of New York City has approved the ordinance of the Municipal Assembly for the issue of $300,000 corporate stock, for the purchase of sites and erection of new buildings for the Fire Department and telegraph system of that Department.

THE BULLOCK AND WAGNER COMPANIES have secured the contract for the new central station, power and lighting plant, to be erected in Nashville, Tenn. It is reported that the General Incandescent Arc Light Company have the sub-contract for switchboard work.

THE ANCHOR ELECTRIC COMPANY has been organized at Youngstown, Ohio, with a capital of $50,000, for the purpose of manufacturing incandescent and arc lamps and other electrical appliances. Youngstown capitalists are the organizers.

HOISTING MACHINERY FOR BRAZIL.—The Brazilian Government is inviting tenders until July 8 for electrical hoisting and transportation apparatus and machinery for transporting locomotives.

BRIDGE FOR SPAIN.—A bridge is to be built at Bilbao, Spain, over the river there, and bids for its construction are invited by the city until July 18.

MACHINE TOOLS FOR NEW SOUTH WALES.—Tenders will be received until July 1 for the supply of machine tools for the government dock workshops on Cockatoo Island, New South Wales.

General News.

THE TELEPHONE.

DUMAS, ARK.—The Arkansas River Telegraph Company has filed articles of incorporation. The capital stock is $5,000. The incorporators are X. J. Pindall, President; W. A. Cheshire, M. W. Snelling, H. O. Pindall and J. Bernhardt.

WASHINGTON, D. C.—The Subscribers' Telephone Association held a meeting in this city a few days ago. The presiding officer, Col. O. G. Staples, stated that the gathering was in the nature of a jollification, on account of the recent decision of the District Court of Appeals, in reversing the opinion of Justice Barnard in the telephone rate case. This case was referred to more particularly in the legal department of our last issue.

LUMPKIN, GA., has begun the erection of a new telephone system.

CORINTH, ILL.—The Crab Orchard Telephone Company, of Corinth, has been incorporated. Capital stock, $2,000. The incorporators are George O. Mitchell, J. L. Dorris and J. L. Roberts.

ANDERSON, IND.—Capitalists of Muncie, Marion, Elwood, Alexandria and this city are arranging a consolidation of all the independent telephone plants in this section of Indiana. George W. Beers, of Fort Wayne, is the leading spirit in the negotiations. Companies are being organized in Muncie and Alexandria, and Councils of both cities have been asked for franchises.

INDIANAPOLIS, IND.—Articles of incorporation were filed with the Secretary of State by the Mansfield and Carbon Co-operative Telephone Company. The capital stock is $2,500. The board of directors is headed by W. N. Simir. The company will build and operate a telephone plant in, and connecting the two towns, and thence branch out into the surrounding country.

HARTFORD CITY, IND.—The Central Union Telephone Company will test the right of the City Council to revoke its franchise. Fifteen years ago the company was granted a franchise, but after a time abandoned the exchange and maintained long-distance service only. The Independent Company recently pre-empted the field, and then the Central Union began to reestablish its office. The Council revoked its franchise.

NOBLESVILLE, IND.—Judge Neal, of this city, denies the story sent out to the effect that he heard testimony in a divorce case by telephone, listened to the argument of complainant's attorney twenty miles away in the same manner, and then granted a decree.

INDIANAPOLIS, IND.—The Central Union Telephone Company has established a new "minute rate" between this city and Terre Haute. The new rate is twenty-five cents for one minute, and five cents for each additional half-minute. It is practically a division of the old rate of forty-five cents for three minutes.

GOSHEN, IND.—W. S. Chapman, auditor of the Central Union Telephone Company, has exonerated W. E. Branson, manager of the local office here, whose accounts were reported tangled. "There was some confusion in his accounts," said he, "but this was due to the position, which is a vexatious one, owing to sharp competition." Mr. Branson has been placed in charge again, and it is claimed that he possesses unusual aptitude for the business.

JASPER, IND.—The Dubois County Telephone Company, which has been working in the vicinity of this city for some time, has opened its exchange to the public, and all subscribers have free service to and with Tell City, Cannelton, Troy, St. Meinrad, Gentryville, Dale, Leavenworth, Corydon, Marengo and all towns along the Air Line east to New Albany, Salem, Paoli, West Baden, French Lick, Winslow, Petersburg and a score of other towns.

NEW ORLEANS, LA.—It is stated that the consolidation of practically all the independent telephone companies of Southwest Louisiana has been effected at New Iberia. The exchanges which got together comprise those of Baton Rouge, Thibodeuax, Teche, Vermillion and intermediate towns, a stretch of territory embracing about 200 miles. The consolidated company will be known as the Louisiana and Texas Long Distance Telephone Company. R. F. Hoggsett was elected president and general manager. The company will apply for a charter at once. It will be capitalized at $150,000, and eventually intends to get into New Orleans.

HOLYOKE, MASS.—The New England Telephone and Telegraph Company will erect an exchange at Maple and Suffolk Streets. The equipment will be equal to that of any exchange in New England.

BALTIMORE, MD.—The Maryland Telephone and Telegraph Company has now in operation over 100 nickel-in-the-slot public telephone pay stations. Meanwhile the Chesapeake and Potomac Telephone Company has begun installing its nickel-in-the-slot telephone machines in residences, but will not change its rate of ten cents a call for public stations. The residence service is on a six to ten party line, while the pay stations are like the Maryland pay stations, on a one-party line. The Chesapeake Company is now fitting up four new branch stations. The Maryland Company has all of its city branches in full operation, and is rapidly getting its suburban stations under way.

LANSING, MICH.—The Springport Telephone Exchange Company has been incorporated with a capital of $500.

ST. LOUIS, MO.—The Craig Telephone Company, Craig, Mo., has been incorporated. Capital stock, $1,000. Incorporators, F. K. Allen, E. J. Kellogg, W. S. Thompson and others.

JAMESON, MO.—The Jameson Telephone Company has been incorporated with a capital stock of $3,500. The incorporators are A. J. Fuller, W. T. Stovall, J. F. Brown and others.

SEDALIA, MO.—The Queen City Telephone Company, which commenced operations January of this year, has a modern plant. Its apparatus and exchange equipment was furnished by the Sterling Electric Company, of Lafayette, Ind. It comprises Sterling standard flash light transfer switchboard, distributing boards, combined cable terminals and protectors, pole top terminals, cable, line fuse protection and instruments. The company began with 400 subscribers, the service being of such a character and so satisfactory that it has been unable to supply the demands of its new patrons. It is fully expected that before the close of this year 1,000 subscribers will be connected with service to this new and progressive exchange.

RALEIGH, N. C.—The Southern Bell Telephone Company is arranging for the construction of a long distance line from Raleigh to Greensboro, which will for the first time put Raleigh in connection with the principal cities. Bonsal & Co., of Hamlet, will furnish 3,000 poles, and the copper wire and cross-bars have already been shipped.

BRIDGETON, N. J.—The Sussex Telephone Company has commenced the work of extending the new telephone line from Blairstown to Newton.

ALBANY, N. Y.—The Hancock Telephone Company, of Hancock, Delaware county, has been incorporated. Capital, $3,000. Directors, E. J. Colter, C. L. Wheeler and S. N. Wheeler, of Hancock.

NEW YORK, N. Y.—The Atlantic Telephone Company, which controls the franchise granted by the former city of Brooklyn to the New York and Eastern Telephone Company, and which alleges that it had a capital of $5,000,000 all paid in, has made application to Commissioner Kearny, of the Department of Public Buildings, Lighting and Supplies, for a permit to use the subways and to string wires.

ALBANY, N. Y.—The Citizens' Telephone Company, of Elmira, has been incorporated, to operate in Elmira and Chemung county, with a capital stock of $250,000. The directors are Charles H. Stewart, Joel H. Fuller, Kerm F. F. Gill, Charles B. Stowe, Byron L. Moore, Bert G. Hubbell, Cleveland, Ohio; Alexander C. Eustace, Charles H. Knipp, Charles A. Pulford and Joseph P. Eustace, Elmira.

HANCOCK, N. Y.—The Hancock Telephone line, owned by Chester B. May, has been merged into a stock company, capitalized at $3,000, and application made to the State officials for a franchise. The directors are Edmund J. Cotter, Clayton L. Wheeler, Samuel N. Wheeler, Chester B. May, Herbert W. Wagner, Austin D. Johnson and Bernard J. Bussman. Following are the officers of the new company: C. B. May, president; W. H. Wagner, secretary; S. N. Wheeler, treasurer; E. J. Cotter, manager. The system will be extended in various directions, namely: To Starlight, Pa., to Rood's Creek, where connection will be made with the Deposit system; to Apex, connecting with the Walton line; to East Branch, Peakville, Horton, Cook's Falls, Rockland. At Craryville connection will also be made with the new Sands Creek line running over to Cannonsville.

FAIRVIEW, OHIO.—The Union Telephone Company has been incorporated with $10,000, to build a local exchange.

UHRICHSVILLE, OHIO.—The Uhrichville-Dennison Home Telephone Company has been sold to Cleveland people.

SPRINGFIELD, OHIO.—The Springfield Home Telephone Company, of Springfield, has been incorporated. Capital stock, $300,000.

CANTON, OHIO.—The United States Telephone Company has completed long distance connection with the Stark County Telephone Company at Canton.

NEWARK, OHIO.—The Buckeye State Telephone Company, of this place, has been incorporated with $10,000 capital stock by local people to build an exchange.

GALLIPOLIS, OHIO.—Work on a new telephone line from Gallipolis, along the river road, via Chambersburg, Crown City and Proctersville, to Ironton, has been commenced.

BURTON, OHIO.—The Burton Home Telephone Company has increased its capital stock from $5,000 to $15,000. A number of improvements and extensions are contemplated.

ASHVILLE, OHIO.—Construction work has been started on the new system of the Citizens' Telephone Company. Work has also been started at Williamsport and Circleville.

ANDOVER, OHIO.—The Jefferson & Warren Telephone Company has 110 telephones at this point, with twenty-five on a waiting list. A new switchboard will shortly be installed.

WILMOT, OHIO.—The Valley Telephone Company, of this place, has been incorporated by H. J. Christman, J. W. Moyer, E. C. Cotton, J. W. Newcomer and A. L. Deal. Capital stock, $1,000. The company will operate lines in Stark, Holmes, Tuscarawas and Wayne counties.

CADIZ, OHIO.—The Harrison County Telephone Company is preparing to establish exchanges in Jewitt, Scio, Harrisville, Freeport and Adena. The company now has 150 telephones in this place, while the Bell Company has only fifty. R. Cunningham is president, and W. W. Potts secretary of the company.

CADIZ, OHIO.—The United States Telephone Company is building a long-distance line from Uhrichsville to Steubenville and Wheeling, through this city, giving long distance connection to the Harrison County Telephone Company's exchange. The Harrison Company is building a number of toll lines to surrounding towns in this county.

EATON, OHIO.—The independent telephone companies of Preble county have appointed a committee consisting of Judge Abram Fisher, Joel Stewart and Ellsworth Horn, to draft a new schedule of rates. The various companies in this county have been unable heretofore to agree on a schedule of toll rates, and many differencees have resulted.

TOLEDO, OHIO.—The Home Telephone Company, which is promoted by Frank Graves and Cleveland parties, has secured nearly 3,000 subscribers. It is stated that arrangements have been made to rent two floors of a large office building for an exchange. The company has not yet secured its franchise from the City Council, but the matter will be settled in the near future.

CINCINNATI, OHIO.—Ordinances to compel telephone companies operating in the villages and towns in West Virginia are being introduced in a number of places in that State. In the main they are aimed to reach those companies

having their principal offices elsewhere, and endeavor to escape the payment of taxes in the little towns by the payment of State, county and district taxes in the place where the main offices are located.

STEUBENVILLE, OHIO.—Manager Sapp, of the Bell Telephone Company here, is installing a private system of thirty telephones in the country residence of J. B. Vandergrift, near this place. Telephones will be placed in all buildings on the grounds, and will be connected to an automatic exchange. Wires will all be placed underground. Local and long distance connection will be given through the exchange here.

DAYTON, OHIO.—After a fight lasting more than two years, the Dayton Home Telephone Company has finally secured from the probate Court a twenty-five year franchise for a local exchange. Under the conditions the company may not sell or transfer its franchise, and the city is given the privilege of buying the system at the end of five years. This is the last large town in the State to secure an independent telephone exchange. Harry Kiefaber is president, and Albert Emanuel secretary of the company. Offices have already been opened, and a number of subscribers have been secured. Contracts for material will be closed at once.

FINDLAY, OHIO.—The new exchange of the Findlay Home Telephone Company will probably be placed in operation in the near future. The switchboard is now being installed. It is of the double supervisory, six panelled multiple type of the central energy system, and equipped with all modern improvements, being the product of the North Electric Company, Cleveland. The ultimate switchboard capacity will be 1,600 and the cable capacity 1,300. The farmers in the vicinity of Findlay are taking up the telephone, and contracts have been closed with 200 farmers. J. R. Firman is manager of the Findlay company, which is promoted by Cleveland people.

CLEVELAND, OHIO.—Application for a charter for the incorporation of the People's Telephone Company of Detroit, which is being promoted by the Everett-Moore syndicate of this city, has been sent to the Secretary of State of Michigan. The company will be capitalized at $2,500,000, 70 per cent of which is controlled by the Federal Telephone Company, of Cleveland, and 30 per cent by Detroit capitalists. Among the directors will be H. A. Everett and E. W. Moore, Cleveland; C. L. Palms, Henry Stevens, Alex. McPherson, J. C. Hutchins, Theodore D. Buhl, of Detroit, and Arthur Pack, of Pontiac, Mich. Work has been started on the underground system, and a site has been purchased for a six-story exchange building. The plant will have a capacity of 12,000, and it is expected will be in operation by February 1, 1902.

SAND CREEK, OKLA.—The Sand Creek Telephone and Construction Company, of Sand Creek, Okla., was incorporated May 25, to operate a telephone line. The incorporators are J. A. Meyer, C. L. Beckendike, J. Lutz, A. H. McMahan and N. A. Silverthorn.

PHILADELPHIA, PA.—The Monroe County Telephone Company, Appenzel, Monroe county, has been incorporated. Capital, $3,000.

BELLEFONTE, PA.—The Central Commercial Telephone Company, of this place, has been purchased by, and merged into, the United Telephone and Telegraph Company, of Pennsylvania.

PITTSBURG, PA.—The United Telephone and Telegraph Company, of Pennsylvania, is endeavoring to acquire a line through to Pittsburg. The company now owns all the independent telephone companies between Philadelphia and Altoona, Pa., and has just purchased a controlling interest in the Central Commercial Telephone Company, of Bellefonte, Pa.

HARRISBURG, PA.—The House has passed the Hosack bill against telephone monopoly. It prevents the consolidation of competing telephone lines or acquisition of the controlling interest in the stock or bonds of competing telephone lines, and provides that where any such company violates the proposed act its franchise, property, stock and bonds shall be forfeited to the Commonwealth.

HILLSBORO, TEXAS.—E. M. Turner, of the Hillsboro Independent Telephone Exchange, has perfected arrangements for the exchange in Dallas. A $40,000 plant will be put in with all the latest improvements. It is the intention of the company to extend lines to every section of the county as rapidly as possible.

KEMP, TEXAS.—The Texas Telegraph and Telephone Company has elected the following named officers: Dodge Mason, president and general manager; J. G. Crawford, vice-president; A. J. Still, Jr., secretary and treasurer; R. B. Still, auditor. It proposes extending its line south to Nacogdoches and Beaumont at once, and the work of rebuilding the line from Corsicana to Tyler is now in progress.

RICHMOND, VA.—The Street Committee has passed an ordinance authorizing the Southern Bell Telephone Company to do business in the city of Richmond.

WILLIAMSBURG, VA.—An arrangement for consolidation between the Newport News and Richmond and Chesapeake Telephone Companies has been effected. Both companies will maintain their corporate existence, but only one system will be operated.

MARSHALL, WIS.—A telephone line is being built through this place to connect Sun Prairie, Marshall, Waterloo and Lake Mills. It is expected that there will be a local exchange at this place.

MILWAUKEE, WIS.—Plans are being made by the officers of the Pere Marquette line to furnish its seven vessels with a system of wireless telegraphy. The Marconi system is most favorable. Land stations so far decided upon would be at Ludington, Milwaukee and Manitowoc.

RAWLINS, WYO.—The Rocky Mountain Bell Telephone Company is arranging to build a telephone line from Battle Lake across the divide to Dixon, Baggs, Hahn's Peak and towns in Northwestern Colorado. Ranchmen and others along the line will purchase stock and will hold a controlling interest in the line.

ELECTRIC LIGHT AND POWER.

SAN FRANCISCO, CAL.—The San Francisco Department of Electricity is extending its underground system under the supervision of W. R. Hewitt, Superintendent of Fire Alarm and Police Telegraph.

SAN FRANCISCO, CAL.—The Nevada Light, Power and Water Company was recently incorporated by Lewis A. Gould, Fred Blauch, Daniel O'Connell, Harry A. Cook, R. C. Van Vleet, H. H. Ferns and S. C. Scheeline. Capital stock, $400,000; subscribed, $700.

SAN FRANCISCO, CAL.—The Sea Power Company was recently incorporated with San Francisco as the principal place of business. Directors, W. S. Duncombe, A. W. Craig, F. Head, P. Crittenden and W. J. Desmond. Capital stock, $1,000,000; subscribed, $2,500.

SAN FRANCISCO, CAL.—The Bay Counties Power Company, which recently completed an electric power transmission line traversing Yolo, Solano, Contra Costa and Alameda counties in California, recently filed a mortgage for $750,000 on all of its property. It gives the Union Trust Company, of San Francisco, a lien on its holdings for that amount.

INDIANAPOLIS, IND.—Specifications are now ready and bids invited for the new public lighting contract for this city.

INDIANAPOLIS, IND.—The Home Heating & Lighting Company is laying conduits for electric lights and power in the mile square granted by council. It is current belief that the public lighting will be awarded to this company, and this was in contemplation when the company first got its franchise. The two companies are believed to have pooled their interests.

CAMBRIDGE CITY, IND.—Several stockholders in the Cambridge City Electric Light Company have filed suit in the Wayne Circuit Court for a receiver. The plant and equipment is modern, but the corporation was practically put out of business recently by the installation of a municipal lighting plant, and the plaintiffs want the affairs of the private concern wound up.

INDIANAPOLIS, IND.—Commercial enterprise, dependent upon electric light and power, is spreading to many small towns throughout the State. During the week articles of incorporation for new industries were filed with the Secretary of State by the Logansport Light, Heat and Power Company, capital $25,000; the Knox Light, Heat and Power Company, capital $10,000; the Jermon Electric Company, of Indianapolis, to manufacture electrical instruments and appliances for physicians and dentists. Several electric light and power companies, incorporated in other States, but doing business in this State, filed articles during the week under the foreign incorporation act.

CLARENDON, MO.—The Clarendon Electric Light and Power Company, of Clarendon, has been incorporated with a capital stock of $6,000. The incorporators are George W. Washington, W. H. Cooke, George T. Morgan and others.

SEDALIA, MO.—Negotiations are pending for the purchase of the properties of the Sedalia Electric and Railway Company, the Sedalia Gas Company and the Sedalia Steam Heating Company, and their consolidation with the Sedalia Water and Light Company.

ST. LOUIS, MO.—According to estimates prepared by expert engineers of the board of public improvements, the three municipal electric light plants to be completed by Aug. 31 will save the city about $115,684.05 in five years. By contract at present meter rates the current would cost $297,725.90 in five years. The cost of the plants and the operation for five years will aggregate $182,041.85.

TRENTON, N. J.—The Butte Electric and Power Company, capital $2,500,000, has filed articles of incorporation. The incorporators are William J. Denning, William W. Mansfield, Charles E. Estabrook, C. R. Dean, Thomas K. Henderson, C. L. Reed, I. F. Keeler, J. S. Anthony and William F. Brayton, all of Jersey City.

FRANKFORT, N. Y.—The citizens of Frankfort, N. Y., have recently voted to bond the village for $18,000, to build a municipal electric lighting plant. Work will begin as soon as plans and specifications can be prepared. Mr. J. F. Tucker is clerk of the board.

WARREN, OHIO.—T. H. and E. W. Gillmer and William Wallace have made application for a franchise to build an electric light plant and heating system in this place.

GENEVA, OHIO.—Citizens of this place have voted against a proposition to bond the village to the extent of $25,000 for the purpose of building a municipal lighting plant.

MT. GILEAD, OHIO.—The Fish-Mansfield Company, of Shelby, has secured a franchise to build a water-works and electric lighting plant here. Construction work will start at once.

PORTLAND, ORE.—The Portland General Electric Company has been granted a permit to erect an auxiliary electric power station. The equipment to be installed includes two engines of 2000-hp and 1200-hp respectively; 15 steam boilers and several generators.

MADISON, WIS.—It is reported that the city will build a $35,000 electric lighting plant.

MANSFIELD, WIS.—The electric lighting plant was on May 22 damaged by fire to the extent of about $4,000.

OSHKOSH, WIS.—This city recently made a ten-year contract for electric street lighting. It is believed to be the lowest contract ever made in the United States for the same amount of service. The price is $48 a lamp per year, the lamps to be of 1,200 candle power each, and of the enclosed arc type. There are 274 lamps, and the saving on the new contract will be $52,342.

MADISON, WIS.—Philip L. Spooner has purchased the water power of the Wisconsin river at Kilbourn City, and will develop the power for operating an electric power plant. Electric energy will be transmitted to Kilbourn City, Madison, Baraboo, Portage and other villages. As Mr. Spooner recently purchased the Madison street railway system, it is expected that the system will be operated from the Kilbourn plant. It is also reported that an electric railway will be built connecting the chain of four lakes. The circuit of the lakes would be some sixty miles in extent.

THE ELECTRIC RAILWAY.

SAN FRANCISCO, CAL.—The San Francisco and San Mateo Electric Railway has been turned over to the Baltimore syndicate, represented by Messrs. Webb and Blackwell. The road will be extended at once from Baden, Cal., to San Mateo, and later to San Jose.

VINCENNES, IND.—A receiver has been asked for the Citizens' Street Railway Company, of this city.

NEW ALBANY, IND.—The New Albany street railway system was sold on May 23 under a decree of the United States Court to Richard L. Veech, of Louisville, for $56,100.

FRANKLIN, IND.—The Indianapolis, Greenwood and Franklin Traction Company, which completed its extension to this city recently, will be extended to Columbus at once.

MUNCIE, IND.—This city will soon be connected by electric railway with Greenfield, through Middletown, Mechanicsburg, Shirley and other towns. A stock company is being organized.

PORTLAND, IND.—Special elections have been called in Knox, Richland and Penn Townships, Jay County, to vote subsidies in aid of the proposed Ohio and Indiana Traction Company.

ROCHESTER, IND.—A committee of Wabash business and professional men visited this place during the week and took up the matter of building a trolley line between the two cities. The distance is twenty-five miles.

INDIANAPOLIS, IND.—A strike among the union linemen has retarded work on the local street railway lines, the Indianapolis light and power plant and the telephone lines. The linemen have been receiving $2.25 per day. They are demanding $2.50 and overtime pay after a nine-hour day.

DELTA, OHIO.—The Toledo & Bryan Air Line Railway Company has applied for a franchise to pass through the center of this village.

CINCINNATI, OHIO.—Promoters of the traction line between Louisville and Maysville are negotiating for the Frankfort and Cincinnati Railway between Frankfort and Paris, Ky.

STEUBENVILLE, OHIO.—General Manager J. C. Ross, of the Steubenville Traction Company, has closed contracts for the extension of the line to Toronto and construction work will start at once.

EAST LIVERPOOL, OHIO.—The East Liverpool Street Railway Company has applied for a franchise for its proposed extension to Wellsville. The company will erect a large car barn at the terminus of the road.

DAYTON, OHIO.—The Dayton & Germantown Traction Company has secured a private right of way from this city to Germantown and Middletown. Surveys have been completed and construction work will start in the near future.

NAPOLEON, OHIO.—The Henry County commissioners have granted a 25-year franchise to the Toledo, Napoleon & Defiance Railway Company. The way granted is along the canal road and the company will occupy that portion adjoining the canal towpath.

CINCINNATI, OHIO.—The Miami and Erie Canal Transportation Company has awarded the contract for overhead material for the electric line on the banks of the canal between Cincinnati and Dayton to the Ohio Brass Company, of Mansfield. The amount is $28,000.

FINDLAY, OHIO.—A company is being organized here to build a line from Findlay to Ft. Wayne, Ind. The incorporators are Dr. W. H. Beggs, Columbus Grove; Dr. H. M. Day, Pandora; C. E. Niles and Dr. J. A. Kimmel, of Findlay; I. H. Whistler, of Benton, and G. W. Reiser, of Ottawa.

STEUBENVILLE, OHIO.—The Steubenville Traction Company has purchased a site for a car barn and repair shop. The former building will be 200 x 50 feet, with capacity for 24 cars, and the latter will be 150 x 25 feet and will be equipped with all appliances for repairing and maintaining cars.

CLEVELAND, OHIO.—The Electric Depot Company, of this city, has been incorporated with $200,000 capital stock by B. Mahler, E. W. Moore, H. A. Everett, A. E. Akins and E. G. Tillotson to build a terminal station to be used as passenger, freight and storage house for the interurban roads entering this city.

TOLEDO, OHIO.—It is stated that a new company, to be known as the Toledo & Port Clinton Interurban Railway, will soon be incorporated to build a line from this place to Port Clinton, following the lake shore. G. W. Acker, C. Dedean, L. Galshall and W. B. Geroe, of Toledo, are said to be promoting the enterprise.

KENTON, OHIO.—The stockholders of the Tiffin & Southwestern Electric Railway Company have organized as follows: Henry Price, president; Robert Carye, first vice-president; W. S. Rogers, second vice-president; J. B. Seymour, treasurer; Thomas Espy, secretary. The capital stock of the company is to be increased from $50,000 to $2,000,000.

COLUMBUS, OHIO.—The Columbus, Delaware & Marion Railway Company has applied for a 25-year franchise between Columbus and Delaware. The company has purchased the Worthington & Flint Railway and the Worthington, Clintonville & Columbus Railway, both of which have franchises, but it desires a blanket franchise over the entire route.

DAYTON, OHIO.—A. E. Appleyard, owner of the Dayton, Springfield & Urbana Railway, and who recently purchased the Dayton, Lebanon & Cincinnati Railway (steam), has announced that the latter road will be equipped for electricity and that passenger cars will be operated during the day time while steam freight trains will be operated at night.

CLEVELAND, OHIO.—The Everett-Moore syndicate is figuring on a number of extensions to the system of the Northern Ohio Traction Company, in addition to those already announced. At a recent meeting of the company it was decided to extend the proposed line from Barberton Wadsworth, on to Medina, thus connecting the county seats of Medina and Summit counties.

LIMA, OHIO.—The Western Ohio Railway Company has secured the right of way for its extension from New Bremen to Sidney and Piqua. To provide for this extension, as well as the one to Findlay, the company will increase its capital stock from $1,000,000 to $2,000,000, and the capacity of the new power station at St. Marys will be doubled by the installation of two 800-kw generators, and engines and boilers to correspond.

CINCINNATI, OHIO.—It is expected that the work of construction on the Indiana & Ohio Railroad, which is being projected by W. H. Schott, of Chicago, will be begun by the middle of July, and that the road will be in operation not later than Jan. 1 next. The line will extend from Fluffton, Ind., south to Pennville, to Portland, to Dunkirk and Redkey, with a branch to Montpelier, thence in a southerly course to Hartford City, a distance in all of fifty miles.

CINCINNATI, OHIO.—The Suburban Traction Company, of Cincinnati, just organized, is officered as follows: Geo. R. Scrugham, president; J. M. Kennedy, vice-president; Lee H. Brooks, secretary, and Guy W. Mallon, treasurer. The line will be twenty-one miles in length, and will extend from Linwood, the eastern terminus of the Cincinnati Traction Company's lines, through Mt. Washington, Fruit Hill, Forestville, Withamville, Amelia, Mt. Holly and Bantam to Bethel, Ohio. The capital stock is $50,000.

OSHKOSH, WIS.—The Board of Trade is endeavoring to interest capital in a project to build an electric interurban railway between this city and Winneconne.

SHEBOYGAN, WIS.—The Common Council has granted a franchise to J. M. Searmann and J. P. Brickbuner to operate an electric railway through the city as an extension to be built this summer to Plymouth and Elkhart Lake. The right of way for the line has been secured.

THE AUTOMOBILE.

FIRE DEPARTMENT AUTOMOBILE.—If the automobile which is to be purchased by the San Francisco Fire Department for Chief Sullivan gives complete satisfaction, the battalion chiefs are also to be similarly provided.

SEEING SAN FRANCISCO IN AUTOMOBILES.—Mr. S. D. Rodgers, president of the Automobile Club of San Francisco, headed a large party of automobilists, who took a number of visiting Congressmen and Senators on a tour of San Francisco and its environs, as a feature of President McKinley's week in 'Frisco.

CROSSING THE CONTINENT ON AN AUTOMOBILE.—Alexander Winton and Charles B. Shanks, who went to the Pacific coast for the purpose of attempting to cross from the Pacific to the Atlantic for the first time in an automobile, left San Francisco for New York on May 20. The route is via Sacramento, Winnemucca, Nev., Ogden, Omaha, Chicago and Buffalo. They carried a packet from Gen. Shafter, Military Commander of the Department of California, to Gen. Miles. Mr. Shanks represents the Cleveland Plain Dealer. The automobile used is a Winton gasoline machine, capable of making thirty miles an hour. They carry tools for clearing the road if necessary.

NEW INDUSTRIAL COMPANIES.

THE HASTINGS ELECTRICAL COMPANY, of Hastings, Pa., has been incorporated with a capital of $3,000.

THE ANTISEPTIC TELEPHONE APPLIANCE COMPANY has been incorporated in New Jersey, with a capital stock of $500,000. The incorporators are E. S. Chambless, T. A. Hickey and P. W. Rider, all of Jersey City.

THE OTIS ELEVATOR COMPANY, with East Orange, N. J., as the principal place of business, was recently incorporated under the laws of the State of California; directors, J. B. Dill, A. S. Bard and L. Calkins; capital stock, $11,000,000.

NEWARK, N. J.—The Federal Development Company has filed articles of incorporation in the County Clerk's office in this city. Its object is to purchase and control lands, power sites, water sites, transportation, telephone and telegraph privileges, to construct and sell railroads, and acquire navigation privileges. The capital stock is fixed at $200,000, divided into 20,000,000 shares of par value of one cent each. The incorporators are Joseph P. Barriclow, Cleveland V. Childs and James R. Mapletoft.

THE ELECTRIC TYPEWRITER COMPANY, having as its purpose the manufacture and sale of a new electric typewriter, with its office in the city of Buffalo, has been incorporated at Albany. The company has a capital stock of $100,000. The typewriter to be manufactured is the invention of George H. Ennis, of Troy. Harry Bates, of Rensselaer, holds a half interest in it. The directors are Edward Michael and former State Comptroller James A. Roberts; his son, Joseph B. Roberts, of Buffalo; Joseph L. McEntee, of Albany, and Harry Bates, of Rensselaer.

LEGAL.

THE CARTY PATENT.—The American Bell Telephone Company is contending in the local United States Circuit Court in Pittsburg against the Anthracite Telephone Company, as to infringement of the Carty bridging bell patent, and the outcome of the litigation is watched by all the telephone interests in the country. The Bell interests are represented by the Western Electric Company, which latter company has asked the court to enjoin the Anthracite Telephone Company from using the Carty method. The plea of the defendant is a priority of use in the device before the patent was issued. The legal representatives of the Bell interests are F. P. Fish, of Boston, and George P. Barton, of Chicago, while the independent companies have their case argued by C. C. Buckley, of Chicago, and R. S. Taylor, of Fort Wayne, Ind. Judges Acheson and Buffington, of the United States Court of the Western District of Pennsylvania, have reserved their decision.

OBITUARY.

MR. C. S. COX, who has been connected with this and other technical journals as correspondent and illustrator for many years, died suddenly on Tuesday morning, May 28. Mr. Cox was not only an expert engraver and draughtsman, but a writer of no mean merit. His technical knowledge of machinery rendered him especially competent in discerning the salient features of power plants or other installations which he was describing. Mr. Cox was about forty-three years old when he died, and leaves a mother.

MR. A. P. BRAYTON, JR., died in Oakland, Cal., on May 12, at the age of thirty-four years, after a very short illness, death being caused by pneumonia. He was unmarried, and was a member of the Masonic order and of the Bohemian Club, besides being very prominent socially and popular with all classes. He was associated with his father in the management of the San Francisco works of the Pelton Water Wheel Company, and he had much to do with the development of the Pelton wheel. The interment took place in Oakland.

MR. J. W. DICKERSON.—The many friends of Mr. J. W. Dickerson will be pained to learn of his death, which occurred on Thursday of last week, at St. John's Hospital, Brooklyn, where he had been ill for about two weeks. Mr. Dickerson was born in 1861, and has been identified more or less closely with electrical journalism for ten or twelve years. In 1886 he went to Chicago from Rochester, N. Y. Soon after he joined the editorial staff of the *Western Electrician*. He left that publication to become the editor of *Electricity*, and thereafter was identified with the *Street Railway Journal* and the *Street Railway Gazette*, of Chicago. He came to New York in June, 1894, and was connected with the *Electric Railway Gazette*, until he was compelled on account of his health to go to Denver, where he made his home for the next three or four years, occasionally visiting his friends in the East. He had only recently returned to New York city to engage again in newspaper work. Mr. Dickerson's friends will always remember with pleasure his unfailing good nature and cheerful disposition, his staunch loyalty to his friends and his strict integrity in all business dealings.

MR. H. V. A. PARSELL.—We regret to state that Mr. Henry Van Arsdale Parsell died last week in New York city, at the age of sixty-eight years. Mr. Parsell was a well-known philanthropist and reformer. He was born in New Brunswick, N. J., and came to New York while a young man. In the early sixties he became assistant secretary of the Young Men's Christian Association, and about the same time was made paying teller of the North River Savings Bank, later becoming secretary of the same institution. He gave up this position in 1889, in order to administer the large estate of his brother-in-law, Norris Peters, and to conduct the celebrated business of photo-engraving founded by Mr. Peters in Washington. Mr. Parsell was a member of the Society for the Prevention of Crime, and spent much of his time at the headquarters of that society. He was treasurer of the New Amsterdam Eye and Ear Hospital, a director in the North River Savings Bank, belonged to the Aldine and Republican Clubs, the Museum of Natural History, the Metropolitan Museum of Art, and the Society for the Prevention of Cruelty to Animals. He was a man of remarkable mechanical and artistic taste, and spent a great deal of his time in his private laboratory, working in wood and iron for his own amusement. It is said that during the last years of his life he gave away a large income in assisting others. He was especially fond of encouraging young men, and his favorite method was to present a bank book with a comfortable sum already entered in it to a youth with an admonition to deposit something every week or every month. His principal work in electricity was galvanoplasty, in which he was very active between 1855 and 1865, doing remarkable work, as evidenced by the loan collection shown at the Electrical Exhibition of 1899. In some of his work the younger Elkington, son of the founder of the famous London firm, was associated with him. In this work he used the Daniell and Smee cells, with modifications to suit the conditions. Mr. Parsell's son, H. V. Parsell, Jr., is well known in the profession as an engineer and inventor of marked ability. The family home had been made by them one of the most interesting laboratories and museums that can be imagined. From cellar to garret it has brimmed over with works of art, curios, scientific specimens, apparatus, tools and costly mechanisms.

PERSONAL.

MR. F. BATHURST, of the Conduit and Insulation Company, London, is to visit this country during the present month on a combined holiday and business trip.

MR. T. D. SMITH, of the United States Signal Corps, has resigned from the service, and is joining the forces of the Davis Coal and Coke Company, West Virginia.

MR. S. DODD, who has for many years past been connected with electrical manufacturing, has become associated with the Stanley Electric Manufacturing Company, of Pittsfield, Mass.

MR. S. G. McMEEN, engineer of the Central Union Telephone Company, gave an address on May 29 before the students of the Armour Institute of Technology, Chicago, on modern telephone practice.

MR. JOHN BLAIR MACAFEE, of Philadelphia, has recently completed the engineering and preparation of maps, profiles, plans and specifications for the Baltimore, Halethrop and St. Denis Railway.

MR. W. L. PROBASCO, of the publishing department of the Westinghouse companies, has gone to Buffalo, N. Y., and will remain at the Pan American Exposition until the exhibits of the Westinghouse interests are completed.

MR. F. A. McCARTY, formerly a contracting engineer for the Westinghouse Electric Manufacturing Company, sailed on May 30 for Sydney, New South Wales, where he will act as electrical engineer for Messrs, Noyes Brŏs. He left by way of San Francisco.

PROF. F. W. SPRINGER, of the department of electrical engineering of the University of Minnesota, passed through New York last week on his way to Europe, where he will spend a five months' holiday in rest and studying of electrical conditions in the old world.

PROF. ELIHU THOMSON is to deliver the annual commencement lecture before the Washburn Engineering Society at the Worcester Polytechnic Institute, in the lecture room of the Engineering Laboratory on Tuesday, June 11. It is the thirty-first annual commencement of the Worcester Polytechnic.

MR. J. H. RIDER, the lately appointed chief electrical engineer to the London County Council, has been engaged for some time on a treatise on electric traction. It will be published in the autumn, and will treat very fully on the different systems of electric tramways. It will be issued in America by Macmillan.

MESSRS. DAVIES MURDOCK, S. W. Hough and J. W. Buckley, of Baltimore, Md., who are connected with an electric railway system in that city, recently arrived in San Francisco to look over the San Francisco and San Mateo Electric Railway, which was recently purchased by the owner of the Baltimore lines.

MAJOR R. B. HOOVER, until recently manager of the Bell Telephone Company's exchange at Springfield, Ohio., has resigned to accept the position of secretary of the National Magneto Telephone Company, of New York. Mr. Hoover will be succeeded by H. P. Miller, who has been identified with the Bell company at Chicago.

DR. AUGUST RAPS, the amiable representative of Siemens & Halske, of Berlin, who has been studying telegraphic and telephonic conditions in this country, has returned from a trip as far west as Chicago, and sailed this week for Germany. He made many friends and acquaintances while here, and found a great deal of technical interest.

MR. PHILIP DAWSON presided at the dinner of the Savage Club, London, May 11. The menu, in pen and ink sketch, bears a neat three-quarter length of the chairman, and is also illustrated with designs showing how the Savages have applied the modern electric tramway service to affairs of the cuisine, so that you can "switch on what you like."

CAPT. WILLIAM BROPHY, formerly of the Boston Wire Department, has left the service, and of late has been doing expert work for the Boston Edison Company and other parties. As one of the most competent experts in the country in regard to aerial circuits, subways and interior wiring, Capt. Brophy should find his services, now happily available, in very general demand.

MR. E. THURNAUER.—A dispatch from Paris says: "The French press and public are beginning to realize the strides made by the Thomson-Houston Company, affiliated with the General Electric Company, of New York. The Metropolitan recently elected two Thomson directors members of its board. Just previously a large company owning tramway systems in ten of the larger French towns elected five members of the Thomson group. A similar thing has happened regarding the Paris Omnibus Company. Mr. Thurnauer, an American citizen, and managing director of the French Thomson-Houston Co., has been appointed general manager of the Paris Omnibus Company's mechanical traction section."

MR. G. G. WARD, of the Commercial Cable Company, who was one of those representing the New York Chamber of Commerce at the reception given by King Edward at Windsor, is quoted by cable as follows: "When we saw the Queen we could scarcely believe it was she; she looked so young and charming. Both the King and Queen appeared to be in splendid health, and they certainly were in the best of spirits." The following is a complete list of the Americans present: Morris K. Jessup, Levi P. Morton, Cornelius N. Bliss, J. Pierpont Morgan, J. Pierpont Morgan, Jr., John T. Terry, George Wilson, Isidor Straus, William Butler Duncan, James Speyer, A. Foster Higgins, Eugene Delano, A. Barton Hepburn, John I. Waterbury, George G. Ward, Levi C. Weir, William H. Parsons, James McCreery, J. W. Pinchot, Vernon H. Brown, George S. Bowdoin and W. Bayard Cutting.

MR. RALPH L. SHAINWALD, president of the Standard Paint Company, New York, the manufacturer of the well-known P. & B. products, sails for Europe on the Feurst Bismarck, June 6, on a business trip, remaining abroad until October. The sale of Ruberoid roofing, P. & B. paints, and other of the P. & B. manufactures in Europe has grown so largely, and is so constantly increasing as to make imperative Mr. Shainwald's trip across the briny, for the purpose of still further enlarging the European factory of the company and increasing the already excellent facilities which the company has for handling its foreign business. Mr. Shainwald will visit the company's branches at London, Liverpool, Belfast, Dundee, Glasgow, Paris, Brussels, Berlin, Munich, Helsingsfors, Hamburg, Turin, Copenhagen, Moscow, St. Petersburg, Amsterdam, Vienna, Odessa and elsewhere. The P. & B. Goods are very popular abroad. In China Ruberoid roofing covers the barracks of both the United States and the German troops quartered there. Ruberoid is also used in the De Beers mines in South Africa. A large lot went to the Klondike a few months ago, while a big quantity accompanies the Baldwin-Ziegler Polar expedition. A great deal of Ruberoid and P. & B. paints is annually sold in Germany, Australia, Spain, Italy, Scandinavia, Russia, Austria, Egypt, West Indies, the Philippines and the Hawaiian Islands.

Trade Notes.

MESSRS. CHARLES A. SCHIEREN & CO., leather belt manufacturers, have opened a branch house in Denver, Colo., at 1315 Sixteenth Street.

THE PERU ELECTRIC MFG. CO., of Peru, Ind., reports large shipments of Pemco rosettes, and is a firm believer in the theory that it pays to advertise a good article.

THE CROKER WHEELER CO. is still hampered by the machinists' strike at its ampere works in New Jersey, but has met the situation quietly and calmly. It has already a large number of new men at work.

BATES FANS.—D. L. Bates & Bro., Dayton, Ohio, have issued their 1901 catalogue of the Bates electric fans. The Bates ceiling fan motors are wound for direct and alternating current; the desk fans for direct current only.

THE INDIANA ARM BRACKET AND PIN COMPANY, of Indianapolis, Ind., reports an unusual large business. This has necessitated doubling its capacity, which now will enable it to promptly take care of the largest orders.

THE ELECTRIC APPLIANCE CO., Chicago, is putting out a high-grade bridging telephone, which is especially recommended for farmers' line work, where a low priced but first class instrument is desired. A catalogue will be sent upon application.

CROSS OIL FILTERS.—The advantages of Cross oil filters are pointed out in a pamphlet just issued by the Burt Manufacturing Company, Akron, Ohio, the manufacturer of this well-known filter. Illustrations show the appearance and construction of the filter.

REMOVAL.—The Russell-Tomlinson Electric Company has removed its factory and offices from Milford, Conn., to Danbury, Conn. In the new quarters the company has doubled its former capacity, and will be able to give prompt attention to all orders and shipments.

THE ELECTRIC STORAGE BATTERY CO., of Philadelphia, manufacturer of the chloride accumulator, has placed the Pennsylvania sales office under the direction of Mr. E. L. Reynolds, who for a number of years has been associated with the company in its New York office.

THE JEFFREY MANUFACTURING COMPANY, Columbus, Ohio, is sending out a circular, No. 61, giving illustrations of its elevating and conveying machinery for mills, factories, mines, industrial and power plants. Most of the views show actual installations of the apparatus.

THE STIRLING COMPANY, of Chicago, has just been awarded the contract for the boilers to be installed at the new Cincinnati water works, at California, Ohio. They are of the water-tube type, of about 2,000 horse power. The order was received through the Cincinnati manager, Ed. K. Gillette.

THE CENTRAL ELECTRIC CO., of Chicago, is Western agent for the Falcon Electric Manufacturing Company, arc lamps, fan motors, panel boards and plugs and receptacles. The Central calls attention to the panel boards and plugs and receptacles. They are made in any finish, and are neat, compact and durable.

ENGINEERING SPECIALTIES.—The Julian D'Esté Company, 24 Canal Street, Boston, Mass., in a forty-page pamphlet of recent issue, describes and illustrates its line of Curtis engineering specialties, including pressure regulators, for steam, hydraulic and air pressure; balanced steam traps, relief valves, separators, etc. These various devices are illustrated.

THIRTY DAYS AFTER.—The B. F. Sturtevant Company has issued a neat little pamphlet, entitled, "Thirty Days After," the meaning of which is that thirty days after the destruction of the electrical department in its works at Jamaica Plain, Mass., the shops were again thoroughly established and in working order. It is a story of enterprise and energy.

SMITH & HEMENWAY COMPANY, New York city, is one of the young and enterprising houses in the tool line, and has forged ahead wonderfully in the past few years. It is the publisher of one of the most novel catalogues issued by any house that we know of. It is called the "Green Book of Hardware Specialties." A copy will be sent free upon application.

MR. ROBERT R. McOAUT, of Indianapolis, Ind., was a welcome visitor to the Chicago office of the Electrical World and Engineer last week. He gives a very favorable report of business in connection with his supply store. He states the demand for Varmach dry batteries and leather nail heads from concerns running small motors is very large, this being their specialty.

ROBERT W. BLACKWELL & CO., Ltd., of London, notify us that they have accepted the resignation of Vicomte E. C. Beuret, the director of their Paris office, and that Messrs. E. Estavard and F. W. Vallat are now in charge of it, under Mr. Blackwell's direct instructions. The office will be conducted as heretofore, at 50 Boulevard Haussmann, and the business steadily developed.

PROFILING MACHINES.—The Garvin Machine Company, Spring and Varick Streets, New York, has issued a catalogue of its line of profiling machines. Among the special points about these machines are that there are no belts to give trouble, they effect great saving of floor space, they are simple in construction, are of high speed and of high efficiency. The various styles of machines are illustrated.

SAFETY LIFT.—The Burr Manufacturing Company, Cleveland, Ohio, makes a safety lift that possesses some features of interest to all requiring a device to lift heavy loads. The principal feature is that in case the rope slips out of the hand when the load is off the ground the rope is locked automatically, thus preventing the load from dropping. A folder issued by the company tells all about the device, and the accompanying illustrations show how it works.

FALSE REPORT OF FIRE.—The Century Motor Vehicle Company, of Syracuse, N. Y., informs us that there is no truth in the recent report that its plant was destroyed by fire. The story is contradicted. The company also states that it is able to take care of any orders that come its way, and in filling what orders it has on hand, notwithstanding the labor agitation among its machinists. Enough men remained at work to enable the company to fulfill its contracts.

STURTEVANT BLOWERS.—The B. F. Sturtevant Company, Boston, Mass., has issued a condensed catalogue of the Sturtevant forges, steel pressure blowers, "Monogram" blowers and exhausters, steel plate planing mill exhausters, counter-shafts, blast gates, disk and propeller fans, steel plate, pulley, steam and electric fans, engines, dynamo motors and generating sets; steam heating, ventilating and drying apparatus; mechanical draft fans, exhaust heads, steam traps, etc. The catalogue has 40 pages, and contains illustrations.

THE WARNER ELECTRIC COMPANY, Muncie, Ind., has just issued a new catalogue of the Warner pole changer for ringing telephones. The device is extensively used, and is stated to be safe, reliable and economical. It has been well received by both the Bell and independent exchanges, and has been on the market three years. The company states that 1,200 of them have been sold in that time. Their use covers nearly every State in the Union and four foreign countries. The catalogue gives detailed information and illustrations of the apparatus.

STROWGER TELEPHONE.—The Strowger Automatic Telephone, 141 to 148 Washington Street, Chicago, have recently been extending their facilities, owing to the increase of demand for their apparatus. From time to time articles have appeared in these pages with reference to their apparatus and plants, and the reports in each case have been favorable to automatic methods. The Strowger Company is of opinion that a large and increasing demand now exists for such apparatus, and that much of the future development of telephony will lie along these lines.

THE GOULD STORAGE BATTERY CO., which is now manufacturing a light output battery, is looked upon with favor by vehicle users, because, with a Gould battery producing from ten to twelve volts per pound, a forty-mile run is possible in a heavy vehicle, whereas in a light runabout, to make sixty miles is equally easy. The Gould shops are running full time, with orders well ahead, yet, as their vehicle battery representative, T. J. Fay, puts it, "There is a lumber factory in the same county, and we can spread a wing to any breeze that blows, provided it floats an order."

THE NEW YORK CENTRAL.—In the special issue of postage stamps to advertise the Buffalo Exposition, the Post Office Department has done honor to the New York Central Railroad, the greatest mail carrier in the world. The one-cent stamp represents the lake navigation with which the Central Railroad connects; the two-cent stamp, the famous Empire State express train; the four-cent stamp, the automobiles used in the Central Railroad cab service; the five-cent stamp, the Niagara Falls bridge, past which the Central trains dash; the eight-cent stamp, the locks at Sault Ste. Marie, through which the Central Road steamers pass, and the ten-cent stamps, the ocean steamers with which the New York Central lines connect and ticket passengers to every part of the globe.

NO FURTHER USE FOR THE CHIMNEY.—One of the most interesting features of the equipment of the new Olympia Mills at Columbia, S. C., is the mechanical draft apparatus. The tall chimney which has heretofore been such a distinguishing feature of a cotton mill is completely done away with and for it is substituted a short steel plate stack extending barely above the roof. Draft is produced by two 14 ft. Sturtevant fans driven by direct-connected engines. An outer shell surrounds the stack, and through the annular space between, air is drawn from the atmosphere down into the fan room. The heat thus acquired is further increased by radiation from the fans. This hot air is finally drawn to the fires through ducts extending beneath the ashpits. The entire mechanical draft plant was designed and built by the B. F. Sturtevant Company, of Boston, Mass.

THE NATIONAL BOARD OF FIRE UNDERWRITERS has recently issued a supplement to the National Electrical Code containing a list of electrical fittings that have been examined and approved by the Underwriters' National Electric Association for use under the rules and requirements of the National Board of Fire Underwriters, for the installation of electric wiring and apparatus. The National Board has also recently published in pamphlet form the rules and requirements for the manufacture of private department fire hose for mill and yard use, as recommended by the National Fire Protective Association. Copies of both of these pamphlets may be obtained by addressing Mr. W. H. Merrill, Jr., secretary, Underwriters' Laboratories, 67 East Twenty-first Street, Chicago.

"ELECTROSE," as an insulating material and substitute for hard rubber, is coming forward in a very interesting manner, and it is a well-established factor with the electrical trade all over the world. It has been in the market about ten years, and has shown that it possesses the qualities necessary to a staple article. We understand that it has been greatly improved lately, and that the Electrose Manufacturing ompany, who already had a large plant at 127 to 137 North Tenth Street, Brooklyn, was obliged to increase its plant and its force of employes, owing to large contracts it has booked for home and export trade. All those interested in hard rubber substitutes will be well repaid by investigating Electrose. It is especially well adapted for telephone appliances, for sheets and special insulation fittings.

ERICSSON TELEPHONES.—We have been informed by the Ericsson Telephone Company, 296 Broadway, New York city, that the Ericsson telephone was awarded first prize at Paris, 1881; Madrid, 1883; Vienna, 1884; Stockholm, 1886; Copenhagen, 1888; Chicago, 1893. Its exhibit in Paris in 1900 was from the St. Petersburg, Russia factory, which was also awarded first prize. This year its exhibit of a fifty-subscriber switchboard, and a few of its different telephones at the Pan-American Exposition at Buffalo, is made in Section 8, of the Electricity Building, and Mr. W. Jac. Marland has charge of the exhibit. The company extends to all its friends and patrons a cordial invitation to see its exhibit and talk over its instruments. It is exhibiting its goods in connection with others in a collective electrical exhibit, which will doubtless prove of interest to many of our readers.

THE HAINES & NOYES COMPANY, Chicago, announces that within the next sixty days it will be ready to fill all orders for its new self-restoring switchboard. This board is designed without the use of the old type drop shutter, and is of the visual signal principle. It makes the work of the operator absolutely sure, and greatly facilitates her work, thus gaining two points of great importance, accuracy and time saving. The visual signal appears when a subscriber calls, as a colored indicator, and locks until the operator answers the call by plugging in, which releases the indicator, when the signal immediately disappears. This signal cannot disappear unless the operator answers the call. The signal cannot appear unless a subscriber calls. A sudden jar of the board will not cause a number to indicate, as in the use of the old-style drop. The jack and signal, which are self-contained and self-restoring, occupy a front space on the board of one and one-quarter inches by one inch, which is exceedingly small—smaller than any other. This board will be used for hotels, private telephone plants, etc., as well as for exchanges.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED MAY 28, 1901.

[Conducted by William A. Rosenbaum, Patent Attorney, 177 Times Bldg., N. Y.]

674,858. CONTACT FOR CONTROLLERS OR REVERSING SWITCHES; J. Trier, Chicago, Ill. App. filed Apr. 26, 1900. The contact is a spring pressed rod carrying a shoe, the arrangement being intended to take up wear.

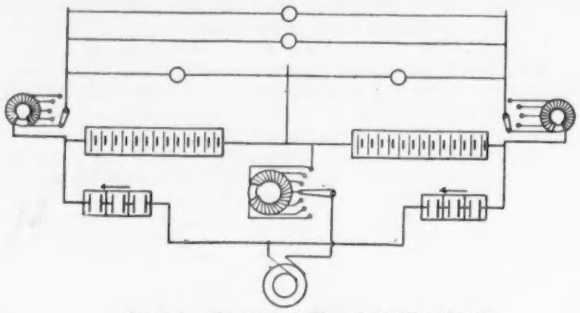
674,860. TELEPHONE CIRCUIT SYSTEM; E. F. Frost, Washington, D. C. App. filed June 27, 1900. A plurality of central offices, a bus-bar at each office, and a common return conductor connecting the bus-bars.

674,861. TELEPHONE CIRCUIT SYSTEM; E. F. Frost, Washington, D. C. App. filed June 27, 1900. Modification of the preceding patent.

674,862. TELEPHONE SWITCHBOARD; E. F. Frost, Washington, D. C. App. filed June 27, 1900. A further modification.

674,867. CIRCUIT OPERATING DEVICE; P. C. Howe, Boston, Mass. App. filed March 12, 1900. A thermostat closes a second circuit if the heat continues after the closure of one circuit.

674,890. STATIC MACHINE; H. E. Waite and H. F. Waite, New York, N. Y. App. filed Apr. 10, 1901. The door of the case containing the influence machine has attached to it a charging machine for initially charging the influence machine.



675,158.—System of Electrical Distribution.

674,927. ELECTRODE FOR ELECTROLYTIC CELLS; M. Mauran, Niagara Falls, N. Y. App. filed March 16, 1900. (See page 980.)

674,930. ELECTROLYTIC CELL; M. Mauran, Niagara Falls, N. Y. App. filed March 26, 1900. (See page 980.)

674,931. ELECTROLYTIC CELL; M. Mauran, Niagara Falls. N. Y. App. filed June 14, 1900. (See page 980.)

674,932. ELECTROLYTIC CELL; M. Mauran, Niagara Falls, N. Y. App. filed Oct. 10, 1900. (See page 980.)

674,933. ELECTROLYTIC CELL; M. Mauran, Niagara Falls, N. Y. App. filed Oct. 16, 1900. (See Current News and Notes.)

674,934. ELECTRODE FOR ELECTROLYTIC CELLS; M. Mauran, Niagara Falls, N. Y. App. filed March 16, 1900. (See page 980.)

674,942. AUTOMATIC CURRENT REGULATOR; S. D. Sprong, Long Branch, N. J. App. filed March 16, 1901. In a regulator for maintaining a constant current in an alternating current circuit, a solenoid, in combination with oppositely located oscillating beams supporting the coils of the solenoid from their outer ends and the core thereof from their inner ends.

674,947. AUTOMATIC REGULATING SWITCH; F. J. Tolchard, Paignton, Eng. App. filed Oct. 29, 1900. Relays are arranged to close one or the other of two motor circuits, the motors therein acting to cut out cells of battery.

674,964. TELEPHONE CIRCUIT SYSTEM; E. F. Frost, Washington, D. C. App. filed June 27, 1900. In connection with the usual instruments, it is proposed to use a line constituting a common return for the telephone line circuit and for the transmitter circuit a battery supply circuit grounded at the central office and at the subscriber's station.

674,981. CONTROLLING ELECTRIC MOTORS; E. C. Parham, Brooklyn, N. Y. App. filed Sept. 23, 1899. (See Current News and Notes.)

674,999. CABLE SUPPORTING CLIP; H. P. Copeland, Jersey City, N. J. App. filed March 26, 1901. A strap doubled upon itself to form loops for the supporting and supported cable, the loops being formed by passing one end of the strap through slits formed in the other end.

675,001. APPARATUS FOR CONNECTING ELECTRIC METERS IN THREE CIRCUITS; J. R. Dick, Brighton, Eng. App. filed March 9, 1900. A three-wire circuit comprising a neutral conductor split into two branches, two substantially equal resistances in the two branches respectively, and measuring instrument in a bridge across the two branches.

675,027. CONTROLLER FOR ELECTRIC CARS; W. W. Tice, Rahway, N. J. App. filed Aug. 1, 1900. Details.

675,033. ELECTRIC ARC LAMP; Curt. Arthur Max Börner, of Berlin, Germany. App. filed July 24, 1900. A plurality of carbons in a parallel row are insulated from each other, and the upper and lower carbon points occupy a staggered relation to each other. The current enters the outermost carbon on one side and leaves the outermost carbon on the opposite side. Means are provided for striking the arc.

675,038. ELECTRIC RAILWAY; P. Farnsworth, Schenectady, N. Y. App. filed May 31, 1900. A railway wherein the only switch coils are in shunts to ground around the car motors from conductor sections which are engaged by the collector carried by the car.

675,049. CIRCUIT BREAKER; S. B. Stewart, Jr., Schenectady, N. Y. App. filed Jan. 21, 1901. The tripping device for the latch is set and released by opposite handle movements.

675,050. ELECTRIC RAILWAY; S. B. Stewart, Jr., Schenectady, N. Y. App. filed Feb. 21, 1901. In an electric railway, the combination with the feeder, of conductor-sections, electromagnetic switches for connecting the feeder with said sections, a resistance carried by the car, and means for automatically cutting said resistance into circuit with the successive switch coils after the latter have been energized.

675,056. MAGNETIC SEPARATOR; Thomas A. Edison, of Llewellyn Park, N. J. App. filed June 12, 1897. The magnetic ore is fed directly on the polar face of an oblong bar electromagnet; the non-magnetic rebound and fall on one side of a partition, while the magnetic particles have their gravitational trajectory changed in passing through the field of the magnet and fall on the other side.

675,065. DEVICE FOR OPERATING AND CONTROLLING ELECTRIC AUTOMOBILES; F. F. Loomis, Akron, Ohio. App. filed Nov. 3, 1900. Details of the steering and controlling stand.

675,066. FIRE ALARM DEVICE; N. Mallander, Minneapolis, Minn. App. filed May 21, 1900. Details.

675,086. ELECTRIC RAILWAY SIGNAL; W. H. Council, Williamsville, Ill. App. filed April 19,1900. Details of track and locomotive circuit for operating block signals in the locomotive cab.

675,087. TRANSMITTER ARM; J. F. Craven, Pittsburg, Pa. App. filed Jan. 9, 1901. The arm comprises two longitudinal members of stamped sheet metal united in such a way as to form a single hollow arm.

675,114. ELECTRIC MOTOR CONTROL; B. C. Shipman, Wilkinsburg, Pa. App. filed June 25, 1900. When the motor is connected on a short circuit to retard the car, a battery is independently connected to the armature circuit and its connections commutated so that groups of successively lower and lower electromotive force are inserted.

675,127. COUPLING FOR CONDUIT OUTLET BOXES; J. P. Cole, Boston, Mass. App. filed Sept. 15, 1900. A threaded sleeve is attached to the box near the opening to afford a water tight connection for the conduit.

675,142. TROLLEY WHEEL; H. W. Smith, Medford, Mass. App. filed March 6, 1901. The inside of the flanges is covered with insulating material, while the thread and the extreme edges are of conducting material, so that when the wheels ride over a frog the circuit will be continuous.

675,158. SYSTEM OF ELECTRICAL DISTRIBUTION; A. S. Hubbard, Belleville, N. J. App. filed April 5, 1900. The invention enables the rectification of impulses in both directions, generated by an alternating-current dynamo, by the provision of two branches or circuits containing such electrochemical rectifying devices oppositely placed, so that impulses in one direction are directed through one of such circuits, while the opposite impulses pass through the other branch.

675,162. MAGNETIC SEPARATOR; B. Noble, Detroit, Mich. App. filed Aug. 27, 1900. A cylinder having magnet poles exposed on its surface and arranged in a staggered relation with respect to each other.

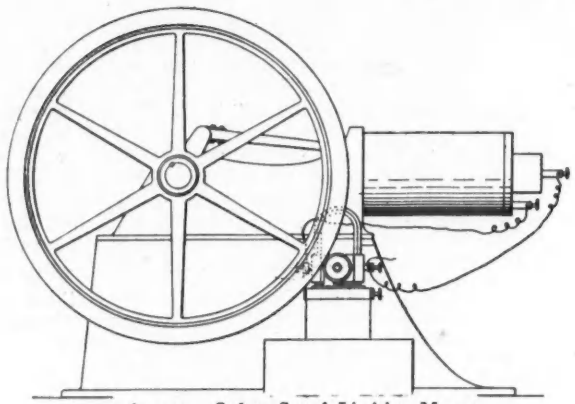
675,177. ELECTRIC SWITCH; G. B. Thomas, Hartford, Conn. App. filed Feb. 15, 1901. An electric switch provided with a moving part, consisting of two pieces of metal, one to receive the mechanical wear, and the other of sheet metal formed with contacts and holding and embracing the first piece.

675,292. VOLTAIC SHOE; E. E. Phinney, Niantic, Conn. App. filed Nov. 3,1900. A voltaic couple is placed in the sole of the shoe.

675,293. CONTROLLER FOR ELECTRIC MOTORS; O. H. Pieper and A. F. Pieper, Rochester, N. Y. App. filed Aug. 27, 1898. Details of construction.

675,294. ELECTRICAL CONTROLLING APPARATUS; O. H. Pieper and A. F. Pieper, Rochester, N. Y. App. filed Feb. 2, 1900. A single switch device controlls a resistance in a shunt around the motor armature, and also the main circuit, there being a permanent resistance in a second shunt around the armature, but in parallel with the variable resistance.

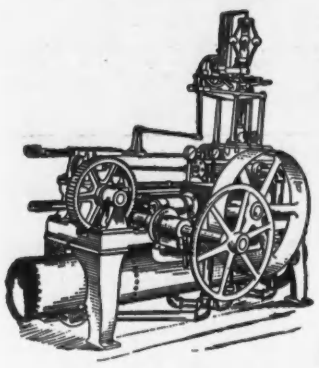
675,303. ELECTRIC FIXTURE BASE; J. W. Smith, Brooklyn, N. Y. App. filed Oct. 15, 1898. A plate having segmental flanges adapted to be engaged by a plug or stem also having segmental flanges, insulating material being inserted between the flanges.



675,351.—Safety Speed Limiting Means.

675,323. LIFTING MAGNET; E. B. Clark, Chicago, Ill. App. filed May 22, 1900. The magnet is provided with a number of pole pieces and coils, and means are furnished for changing the polarity of groups of pole pieces to adapt the magnet for different kinds of work.

675,351. SAFETY SPEED LIMITING MEANS; G. W. Henricks, Indianapolis, Ind. App. filed March 14, 1901. The pulley of a small dynamo for gas engines is driven by the air current created by the rotating fly-wheel of the engine.



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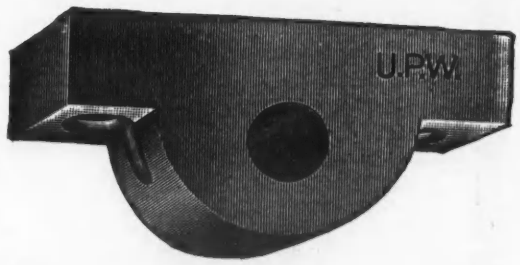

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2—100 K.W. General Electric M.P.
1—150 " Edison bi-polar.
2—100 " Edison bi-polar.
2— 90 " M.P., T.-H.
2— 80 " M.P., T.-H.
2— 75 " M.P., T.-H.
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2—200 " G. E., M. P.

500 VOLT MOTORS.

1— ½ H.P. Crocker-Wheeler.
1— 1 " Crocker-Wheeler.
1— 2 " Eddy.
1— 3 " C & C.
1— 10 " C & C.
1— 6 K.W. M.P., G. E.
2— 10 H.P., M.P. Perrett, slow speed.
1— 15 " Edison.
1— 20 " Jenney.
1— 35 " G. E., M. P.
1— 15 " G. E., M. P.
1— 30 K.W. M. P. Excelsior.
2— 5 H.P. C & C.
1— 75 " Edison.

220-VOLT APPARATUS.

4—200 K.W. Walker M.P.
10—25 H.P. G. E. 52, Ry type stationary motors.
4—10 " Lundell, slow speed motors.
1—45 K.W. 250-volt Edison.
1—7½ H.P. Edison.
1— 4 H.P. Edison.
1— 5 " Edison.
1— 5 " M.P. Excelsior.
1—10 " M.P. Excelsior.
1—10 " bi-polar Excelsior.
1—10 " enclosed type G. E.
1—25 K.W. Eddy dynamo, direct-connected to Russel engine.
1—25 " Eddy dynamo, direct-connected to Skinner engine.
1—25 H.P. Sprague.
2— 7½ " Crocker-Wheeler.
1— 1 " Eddy.

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2—400 " G. E. Inductor, 6600 volt.
1—240 " G. E. single phase, 1154-volt.
3—A120 K. W., T.-H., G. E. 1140 volts.
3—A100 " T.-H., G. E. 1140 volts.
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1—100 " G. E. 3-phase, 60-cycle, 2280 volts.
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1—A70 " 1140 volts.
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2—30 " Westinghouse, 1140 volts.

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1—10 " Excelsior, 60-cycle, single phase.
1—4 " Wagner, 125-cycle, single phase.
1—1 " Emerson, 60-cycle, single-phase.
1—250 " Westinghouse, 60-cycle, 2-phase.
2—100 " G. E., 60-cycle, 3-phase.
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2—15 " Edison bi-polar.
2—20 " Edison bi-polar.
3—25 " Edison bi-polar.
3—30 " Edison bi-polar.
1—100 " Edison bi-polar.
1—D50 K.W., T.-H.
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1 750 " Wood, 37½ K.W., 11,000 volts.
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1 1200 " Siemens & Halske, 60 K.W., self-oiler, 60 cycle, single phase, revolving field type.
4 1200 " General Electric A 60, composite wound, toothed armature.
1 1200 " Westinghouse, 60 K.W., 60 cycle.
1 1200 " Siemens & Halske, 60 K.W., brand new, 60 cycle, single phase.
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1 12 " Card, self-oiler.
1 20 " Sprague, self-oiler.
1 20 " T.-H., D 20.
1 20 " Siemens & Halske, self-oiler.
1 25 K.W., C. & C., self-oiler.
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2 40 " General Electric, M.P., new.
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1 60 " Siemens & Halske, M.P. type, brand new, for direct connection.
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1 25 " Commercial, self-oiler.
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2 40 " General Electric, M.P., self-oilers, compound, new.
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1 60 " Edison, self-oiler, compound.
? 80 " General Electric, M.P., 80, comp., self-oiler.
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1 100 " General Electric, M.P., 100, self-oiler, comp., slotted armature, August delivery.
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1 150 " Westinghouse, M.P., compound, self-oiler.
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1 2 " Mayo, slow speed, self-oiler.
1 3 " Jenney, self-oiler.
1 3 " Standard, self-oiler.
1 3 " Card, Cincinnati, M. P.
1 4 " Mather, self-oiler.
1 4 " Edison, self-oiler.
3 5 " Westinghouse, self-oilers.
1 5 " Commercial, self-oiler.
1 5 " Westinghouse, M.P., self-oiler.
2 5 " Siemens & Halske, M. P.
1 6½ " C & C, M.P.
1 7½ " Eddy, type C, self-oiler.
1 7½ " Card, self-oiler.
2 7½ " Westinghouse, M. P., self-oilers.
1 7½ " Gibbs, M. P.
1 9 " Gibbs, M.P.
1 10 " Edison, 8½ K.W., self-oiler.
1 10 " Card (Cincinnati), self-oiler.
2 10 " Gibbs, M.P.
1 12 " Eddy, self-oiler.
1 15 " Rockford, self-oiler.
3 15 " Edison, 12 K.W., self-oilers.
1 15 " Siemens & Halske, M. P.
1 18 " T.-H., D. 15.
1 18 " Commercial, self-oiler.
1 18 " Eddy, self-oiler.
2 18 " Card, self-oilers.
3 18 " Edison, 15 K.W., self oilers.
1 20 " Eickmeyer.
1 20 " Columbian, M. P.
3 20 " Westinghouse, M. P., slow speed, self-oilers.
1 24 " Eddy, self-oiler.
1 25 " Western Electric, self-oiler.
1 25 " Edison, 20 K.W., self-oiler.
1 25 " Duplex, M. P., self-oiler, slow speed.
1 25 " National, self-oiler.
1 25 " Siemens & Halske, self-oiler.
1 25 " Fisher, M. P., self-oiler.
4 35 " Edison, 30 K.W., self-oilers.
2 35 " Siemens & Halske, self-oilers.
2 50 " General Electric, M.P., 40 K. W., slow speed, new.
1 50 " Westinghouse, 10 pole, slow speed, 40 K.W., self-oiler.
2 60 " General Electric, M. P., self-oilers, 50 K.W., new.
1 75 " Siemens & Halske, 60 K.W.

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1—400 " G. E. (new).
2—300 " Stanley, direct connected to McI. & S. engines.
2—300 " Stanley (belted).
1—120 " Westinghouse.
1—120 " General Electric.
1—100 " Wood.
2— 70 " T. H.
2— 60 " General Electric.
2— 60 " Westinghouse.
1— 50 " Wood.
1— 50 " Westinghouse.
1— 45 " "
4— 35 " T. H.
3— 30 " General Electric.
1— 30 " Westinghouse.

ARC DYNAMOS.

2—160-Light No. 12 Brush, multi-circuit.
1—125 " Brush.
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1— 50 " T. H.
2— 45 " Brush.
2— 35 " T. H.
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16,000 alternations, 100 volt.
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6—12-inch " Lundell, 100 volts.
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Fans overhauled in excellent condition.

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1—100 H.P. 13x12 Phoenix Engine.
2—100 K.W., 6-pole, Triumph, 110-volt Generators.
2—50 K.W. Triumph multi-polar, 110-volt Generators.
2—50 K.W. Jenny bi-polar, 110-volt Generators.
2—25 K.W. Jenney bi-polar, 110-volt Generators.
1—250 H.P. Worthington Water Tube Boiler, good for 135 pounds Hartford.
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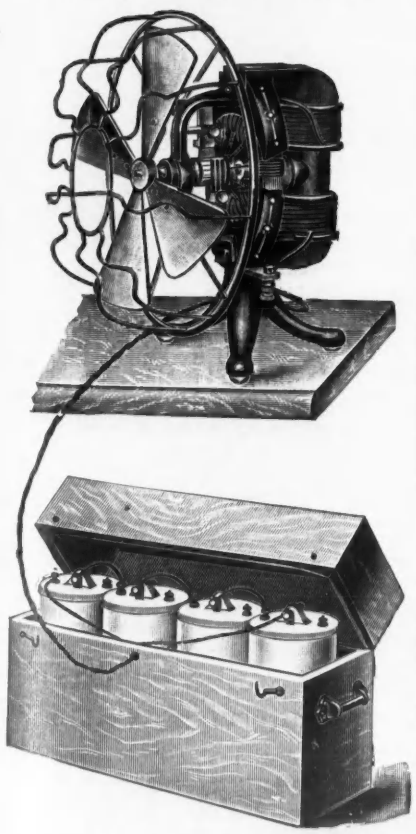

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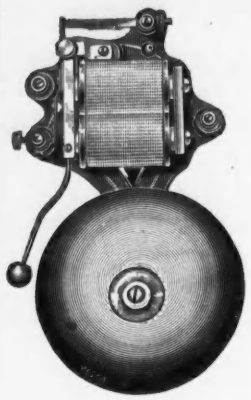

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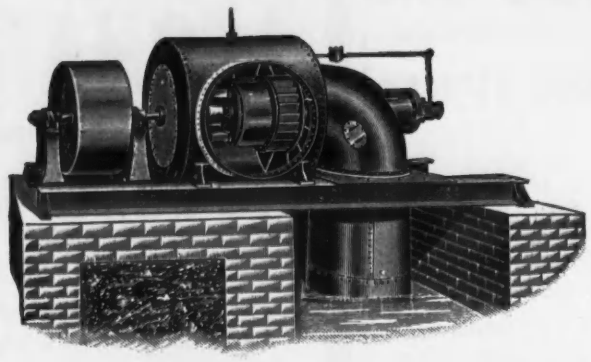

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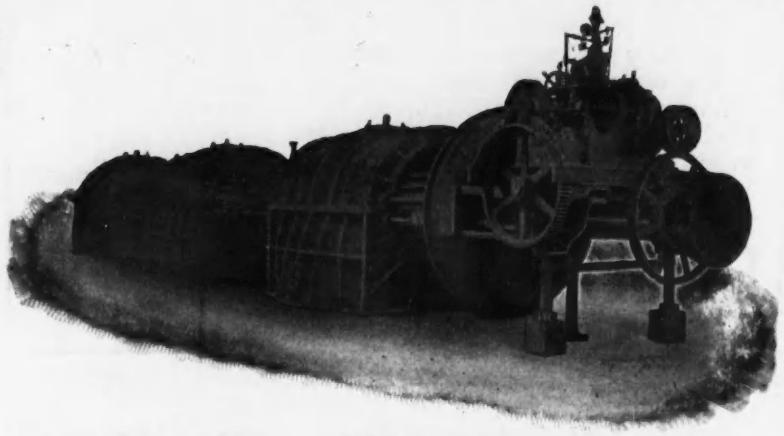

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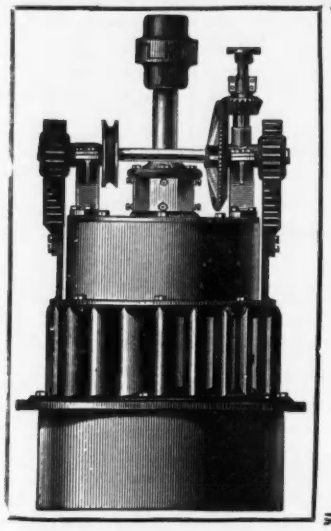

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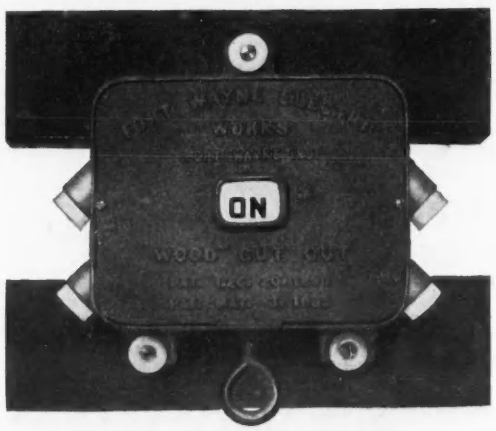

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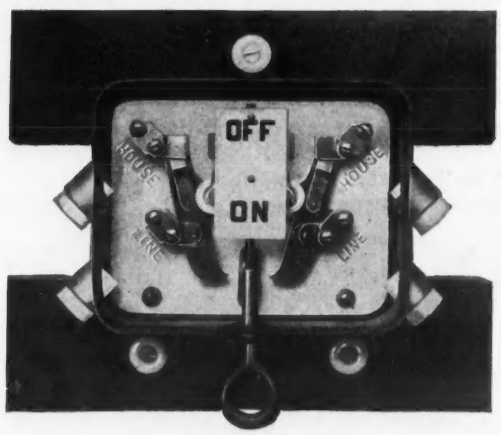

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